Review of the status of EWS in Shimla City (2014 Vs 2018)

Final Report

Citation

Desclaimer

Contents

Summary

National Disaster Management Plan 2016, State DM Plans as well as Sendai Framework for Disaster Risk Reduction (2015-2030) calls for the setting up of **People centric end to End Early Warning System** as one of the key component of the DRR Framework. From the many of recent examples, it is evident that EWS can play a major role in reducing the mortality as well as sufferings of the people.

The city of Shimla is located in a geographically and environmentally fragile area and is vulnerable to multiple disasters. The city lies in the Himalayan region located in the Zone IV and V (about 99.62% area falls in Zone IV and 0.38% falls in Zone V) making the region liable to experience the earthquake of intensity MSK VIII or more. In addition to it, river Satluj, Giri, Pabar and their tributaries flow through renders the population living on the banks of these rivers susceptible to floods which can occur naturally or due to human activities. Recent times due to the increasing developmental activities including construction and road cutting the landslides are on the rise. Further the Shimla being enriched with the green cover leads to irreparable losses during summers due the incidents of forest fire. As consequence of climatic changes and resultant chronic stress and extreme weather events human lives and property is becoming more vulnerable to the disaster.

Aim of the present study is to review and revise the previous study on Early Warning System in Shimla carried out in 2014 and highlight the additional up gradation/systemic changes that have taken place since then. The key elements of EWS and the progress made under the various indicators were analysed keeping 2014 as base line.

UNISDR methodology has been widely accepted and been used for monitoring the progress achieved under the Target G i.e. substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030. Since the analysis was focussed on the progress made since 2014, instead of selecting indicators directly from WMO check list, rearrangement of indicators used in the 2014 study has been attempted. Methodology followed is similar to the previous analysis carried out in 2014. First step was to develop criteria development matrix and this step was followed by Key Informant Interview of officials and staff working the concerned department. Besides experts informal interview cum interaction of people living in the area was also attempted. House hold survey was also carried out to understand the effectiveness at user level.

The report is structured in 11 Sections. Section 1 is on the background, 2 on the aim, 3 objectives, 4 methodology, 5 City profile and 6 on the hazard scenario. Criteria development matrix has been revised with new indicators and the progress has been indicated in section 7 of the report. Section 8 is the analysis of the house hold survey data and the key inferences. Section 9 is on the highlights of the analysis and this

was following by a SWOT Analysis and way forward with specific recommendations for short medium and long term is included.

1. Background

The geographical location of Shimla is such that it is environmentally fragile and ecologically highly vulnerable to multiple disasters. It lies in Himalayan region located in the Zone IV and V (about 99.62% area falls in Zone IV and 0.38% falls in Zone V) making the region liable to experience the earthquake of intensity MSK VIII or more. In addition to it, river Satluj, Giri, Pabar and their tributaries flow through renders the population living on the banks of these rivers susceptible to floods which can occur naturally or due to human activities. Recent times due to the increasing developmental activities including construction and road cutting the landslides are on the rise. Further the Shimla being enriched with the green cover leads to irreparable losses during summers due the incidents of forest fire. As consequence of climatic changes and resultant chronic stress and extreme weather events human lives and property is becoming more vulnerable to the disaster.

To address the needs of the city, in the recent years Himachal Pradesh state has made substantial efforts in terms of enhancing the risk knowledge, strengthening forecasting and EW Capabilities, dissemination mechanisms and also response capabilities. Risk Assessment has been carried out for the city of Shimla and also for the entire state at district level by the disaster management department. In addition, climate change vulnerability assessments were carried out by science technology and environment department of the state with the support of GIZ at district level. Further village level assessment is carried out for 4 districts of Himachal Pradesh. Disease surveillance systems also witnessed substantial progress since 2017 in the state of HP.

The Sendai Framework for Disaster Risk Reduction 2015–2030 – the successor instrument to the Hyogo Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disasters – recognizes the benefits of multi-hazard early warnings systems as one of its seven global targets: “Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030”. The Sendai Framework urges a paradigm shift in the way risk information is developed, assessed and utilized in multi-hazard early warning systems, disaster risk reduction strategies and government policies. It states “in order to reduce disaster risk, there is a need to address existing challenges and prepare for future ones by focusing on monitoring, assessing and understanding disaster risk and sharing such information and on how it is created; strengthening disaster risk

governance and coordination across relevant institutions and sectors and the full and meaningful participation of relevant stakeholders at appropriate levels". The Framework aims to achieve "the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries". In the year 2013-14 an assessment of the EWS in Shimla has been carried out and given specific recommendations for addressing the 4 pillars of successful end to end early warning system. The present study will be focussed on the change in status of EWS since 2014. Besides the indicators identified in the previous report, climate vulnerabilities and chronic stress related problems also will be covered under the present study. Climate Change is likely to have adverse impact in HP state and extreme weather events are reportedly increasing. Recent times the city is facing chronic stress issues particularly water scarcity as evident during 2018 Summer months. Early warning also need to expand to address these issues besides the already identified hazards.

2. Aim

Aim of the study is to review and revise the previous study on Early Warning System in Shimla carried out in 2014 and highlight the additional up gradation/systemic changes that have taken place since then.

3. Objectives

The following are the key objectives of the study

1. To review the technical design/structure and efficacy of existing early warning system on the lines of the 2014 report
2. To review the technologies involved in the early warning system network design, technical specifications, up-time performance standards, connectivity and integration with all the important facilities and installations, emergency services, and the DM system in the city as done in the previous report.
3. To review the mode of collecting information related to hazard events, monitoring, and transmitting it to other agencies, particularly the municipal government and district administration and any updating in the methodology used post 2014.
4. To review the mode and reach of the warning especially last mile connectivity and dissemination plan through mass media, print and audio-visual.
5. To review the messages disseminated through the EWS: on timeliness, appropriateness, accuracy, and simplicity parameters.
6. To review the service support for maintaining the EWS on a regular basis and ensuring 100 percent uptime.
7. To identify the areas through which the EWS of the city could be strengthened and made robust

4. Methodology

The following 3 step process will be adopted for carrying out the study.

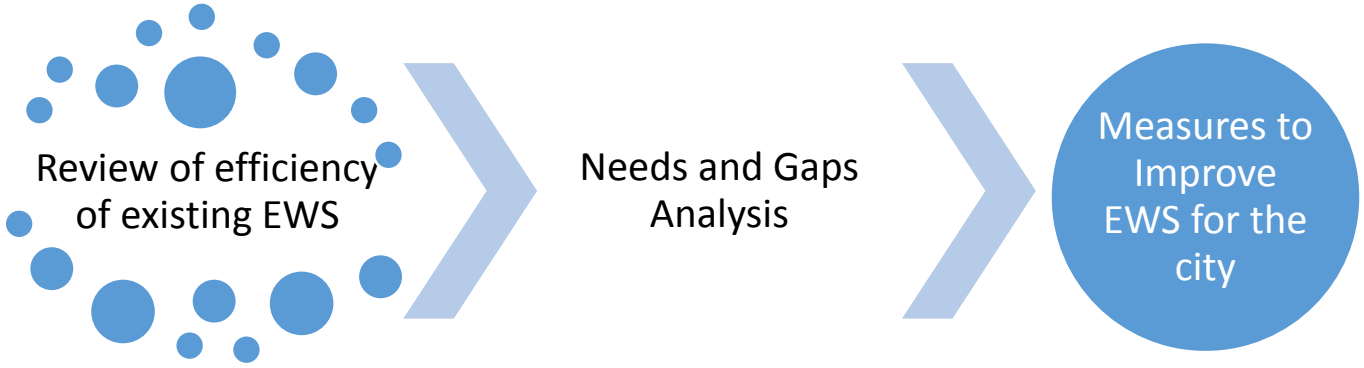
4.1 Review of existing EWS

Efficacy of the existing early warning system will be analysed based on the progress made in the 4 elements of End to End Multi hazard Early Warning System. Multi-sector and multi-tier approach will be adopted for the assessment.

The following key elements of End to End EWS will be analysed in terms of the progress achieved since 2014.

1. Risk Knowledge – A comparative analysis of the knowledge of hazards and risks and mechanism for collection, collation, analysis and dissemination of risk information at different levels during the year 2014 and present will be carried out. This will be done by collecting and collating reports and information from different departments and web sources. Secondary data analysis will be followed by interview of officials from concerned departments. Interview of district collector, municipal commissioner and key government departments will be carried out. Besides analysing the status of existence of information, it is important to understand how far the HVRA has been used by different department particularly for Early Warning Systems. Analyse whether the information about the people with disability, elderly population, women and children also included as a part of risk assessment at local level (at least at ward level). Besides this KII and FDGs can be conducted for selected wards to understand the risk knowledge level of different stakeholders. School teachers, NGO representatives, Ward level elected members and SHG members can be the target group for FDG and KII.
2. Monitoring and Warning Services – A comparative analysis of the Monitoring and Warning Services existing in the year 2014 and now will be analysed. This includes availability of technology and services at various levels during 2014 and now for different hazards. Besides the technology available redundancy, lead time, accessibility and financial resources also will be analysed. Interviews of the key line departments will be carried out to understand whether the departments have own systems for monitoring and warning floods, landslides, disease outbreaks etc. The key parameters to be assessed are whether the right parameters are being monitored, how the monitoring is being done i.e. based on scientific knowledge, tradition knowledge or combination of both as well as the timeliness of the warning. This can be carried out by formative observations as a part of the field visit followed by KII.
3. Dissemination of Communication - Existence of monitoring and warning system is not enough to save lives and reduces damages and loss. The warning to be reached to the people who are at risk timely. Analysis of the parameters viz. availability of dissemination systems which includes the technical and institutional mechanism will be carried out. Indicators can be the existence of EOCs, local level dissemination mechanism through NGOs, natural leaders, religious places etc., mobile based (i.e. sms), radio, TV etc and how the systems were improved since 2014. Interview of the community representatives to be carried out to make sure that the warning messages are been understood clearly or not. Analysis will be being carried out whether specific mechanism for dissemination of warning to people with disabilities and other vulnerable groups are existing or not. FDGs at Ward level with representatives from community will be carried out for collecting information about dissemination mechanisms and their effectiveness before 2014 and present.
4. Response Capability – Response Capability will be assessed at different levels i.e. at the city level whether having enough

technical, financial and human resources to respond to disasters and also whether the response capacity has been improved since 2014. Response capacity of the Emergency Response Functionaries and Critical Infrastructure facilities will be carried out. Analyse whether the city is having up-to date information of readily available resources (similar to IDRN) and Decision Support Systems for responding to disaster warnings. The study will also identify and analyse the trained people at ward level for emergency evaluation and basic lifesaving skills. Schools, Community halls, hospitals and other safe shelters were existing near to the high-risk areas will be analysed.



End to Early Warning System Components and indicators for assessment (adapted from WMO)

Early warning is a major element of disaster risk reduction. It can prevent loss of life and reduce the economic and material impacts of hazardous events including disasters. To be effective, early warning systems need to actively involve the people and communities at risk from a range of hazards, facilitate public education and awareness of risks, disseminate messages and warnings efficiently and ensure that there is a constant state of preparedness and that early action is enabled. The study carried out in the year 2014 is considering 6 components of the Early Warning System (UNDP& TARU, 2014).

However, in the present review, 4 components of the the EWS as identified by UNISDR and WMO will be reviewed. These four components need to be coordinated across many agencies at national to local levels for the system to work. Failure in one component or lack

of coordination across them could lead to the failure of the whole system. The roles and responsibilities of various public and private sector stakeholders for implementation of EWS should be clarified and reflected in the national to local regulatory frameworks, planning, budgetary, coordination, and operational mechanisms to successfully implement end to end EWS.

1. Analyses of risks involved;
2. Detection, monitoring and forecasting the hazards;
3. Dissemination of timely warnings - which should carry the authority of government;
4. Activation of emergency plans to prepare and respond.

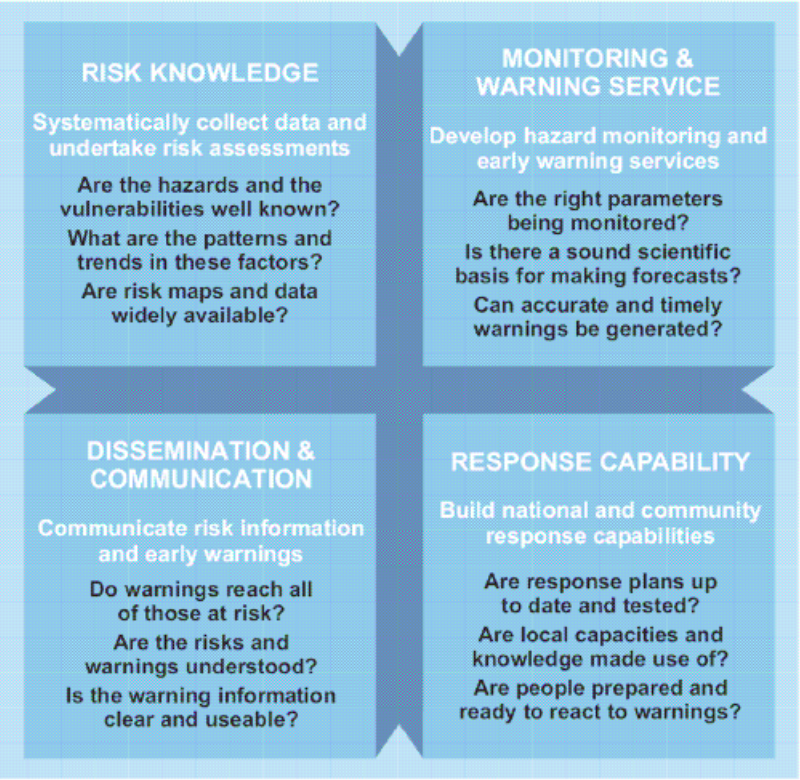


Figure 1: Elements of Successful EWS
(Source: UNISDR Platform for Promoting EWS)

Component 1 - Disaster Risk Knowledge

Comprehensive information on all the dimensions of disaster risk, including hazards, exposure, vulnerability and capacity, related to persons, communities, organizations and countries and their assets.

Risks arise from the combination of hazards, exposure of people and assets to the hazards and their vulnerabilities and coping capacities at a location. Assessments of these risks require systematic collection and analysis of data and should consider the dynamics and compounding impacts of hazards coupled with vulnerabilities resulting from unplanned urbanization, changes in rural land use, environmental degradation and climate change. The level of risk can change depending on the actual impacts and consequences of hazards. Therefore, the risk assessment must include an assessment of the community's coping and adaptive capacities. It is also important to gauge the perception of the level of risk faced by those who are vulnerable. Studies of human interaction and reactions to warnings can also provide insights to improve the performance of early warning systems. Risk assessments should be used to identify the location of vulnerable groups, critical infrastructure and assets, to design evacuation strategies including evacuation routes and safe areas, and to expand warning messages to include possible impacts. For example, maps based on risk assessments help to motivate people, prioritize needs and interventions and guide preparations for disaster risk management measures, including prevention, preparedness and response.

Key Actors

National, subnational and local disaster management agencies; scientific and technical agencies such as meteorological and hydrological organizations, health authorities and geophysical agencies; engineers; land use and urban planners; researchers and academics (including from social science); organizations and community representatives involved in disaster/emergency and disaster risk management

Checklist / Indicators

1. Are key hazards and related threats identified?
    - Characteristics of key hazards (e.g. geographical extent, magnitude, intensity, disease transmissibility, frequency, probability), including possible cascading hazardous events, are analysed, historical data evaluated, and potential future risks assessed.
    - Hazard maps (dynamic and multi-hazard, when possible) are developed that identify the geographical areas/people that could be affected by hazards
2. Are exposure, vulnerabilities, capacities and risks assessed?
    - Assessment and quantification of exposed people, services (e.g. hospitals) and critical infrastructure (e.g. electricity and water work, quality of building stock) conducted and mapped for all relevant hazards, as well as of any compounding risks, at local level in both rural and urban areas.
    - Impacts to critical infrastructure and secondary risks associated with these impacts are evaluated, and risk management solutions considered to increase resilience.

- Vulnerability factors such as gender, disability, access to infrastructure, economic diversity, societal inequalities and environmental sensitivities considered
- Vulnerabilities of key economic sectors at national to local levels assessed
- Historical and indigenous knowledge integrated into risk assessments
- Activities that increase or compound risks (e.g. urbanization and land use) identified and evaluated
- Risk assessment results integrated into local risk management plans and warning messages in a clear and easy-to-understand language with attention to how different people assess information
- Legislation and cultural norms assessed to identify gaps that may increase vulnerability

3. Are roles and responsibilities of stakeholders identified?

- Key national government agencies involved in risk assessments (including hazard, vulnerability and capacity assessments) are identified and roles defined
- Legislation or government policy mandating the preparation of hazard, vulnerability and capacity assessments for all areas are in place
- Responsibility for coordinating hazard identification and risk information (exposure, social and physical vulnerability and capacity) assigned to one national organization with a view to consolidating approaches and monitoring linkages and cascading impacts
- Process developed for scientific and technical experts to assess and review the accuracy of risk data and information
- Process developed to actively engage rural and urban communities in local hazard and risk assessments taking into consideration the needs of all people (women, children, older people, people with disabilities, etc.)

4. Is risk information consolidated?

- Central standardized repository (including but not limited to a Geographic Information System) established to store all event/disaster and risk information
- National standards (where possible, following international standards) established for the systematic collection, sharing and assessment of risk information and data related to hazards, exposures, vulnerabilities and capacities
- Standardized vulnerability data and information disaggregated by sex, age and disability
- Process established to maintain, regularly review, and update risk data, including information on any new or emerging vulnerabilities and hazards, with roles and responsibilities of stakeholders identified along with appropriate funding.

5. Is risk information properly incorporated into the early warning system?

- Information on the geographical extent of hazards used to define safe areas and evacuation zones

- Risk information on vulnerable groups (hazard, exposure, differential vulnerability) used to identify and define evacuation routes and location of temporary shelters
- Risk information on different types of assets reviewed to outline procedures to minimize damage or loss of such assets once a warning is issued
- Process established for continuous update on new or emerging risks (e.g. due to urban expansion or establishment of new settlements) and potential changes to some hazards (due to changes in land use) to update safe areas, evacuation zones and shelters

Linkages with Other Elements

Understanding the risk profile of the country provides critical information for the other multi-hazard early warning system elements, namely:

Detection, monitoring, analysis and forecasting: Identification of what hazards to monitor, where to monitor and how to optimize the observing and monitoring network. It is critical that warnings include risk and impact information.

Warning dissemination and communication: Evaluation of communication strategies to ensure messages are reaching the population and of whether the communication equipment can withstand an extreme event.

Preparedness and response capabilities: Development of disaster preparedness and response plans, development of exercises to test and optimize the effectiveness of dissemination mechanisms, emergency protocols for evacuation and disaster response, and development of public awareness and education campaigns

Component 2 - Detection, Monitoring, Analysis & Forecasting of Hazards and Possible Consequences

Multi-hazard monitoring and forecasting service with a sound scientific and technological basis

Warning services lie at the core of an early warning system. There must be a sound scientific basis to the system and reliable technology for (i) monitoring and detecting hazards in real time or near real time; and (ii) providing forecasts and warnings 24 hours a day, 365 days a year. It must also be monitored and staffed by qualified people.

Continuous monitoring of hazard parameters and their precursors (when available for a particular hazard) is essential to generate accurate warnings in a timely fashion that allow sufficient time for the affected community or communities to enact their disaster management plans appropriate for that hazard. The systems used for detection and monitoring, which could be automated, should allow for strict quality control of the data under international standards when these are available. Warning services should have a multi-hazard perspective (e.g. heavy rainfall may not only trigger flooding but also landslides, the warning for which may come from a separate authority) and be coordinated whenever possible to gain the benefit of shared institutional, procedural and communication networks and capacities. Data, forecasts and warnings should be archived in a standardized way to support post-event analysis and improvements of the system over time.

Key Actors

National and local disaster management agencies; scientific and technical agencies such as meteorological and hydrological organizations, health authorities, ocean observing organizations and geophysical agencies; universities and research institutes; private sector equipment suppliers; telecommunication authorities; security experts; military authorities; quality management experts; regional technical centres.

The Checklist

1. Are there monitoring systems in place?
    - Monitoring network established that monitors hazards that impact the country
    - Measurement parameters and specifications documented for each relevant hazard
    - Technical equipment, suited to local conditions and circumstances, in place and personnel trained in its use and maintenance
    - Monitoring data received, processed and available in an interoperable format in real time or near real time
    - Monitoring data and metadata routinely curated with quality controls, archived and accessible for verification, research purposes and other applications
    - Monitoring hardware and software maintenance conducted routinely, and costs and resources considered from the beginning to ensure optimal operation of the system over time
    - The system can combine and benefit from new and older technology allowing for exchange of data among countries with different technical capabilities
2. Are there forecasting and warning services in place?
    - Data analysis and processing, modelling, prediction and warning products generated based on accepted scientific and technical methodologies and disseminated within international standards and protocols
    - New data analysis and processing, modelling, prediction and warning products can be integrated easily in the system as science and technology evolve
    - Warning centres are always operational (24 hours/day, seven days/week) and staffed by trained personnel following appropriate national and international standards
    - Warning messages are clear, consistent and include risk and impact information and are designed with consideration for linking threat levels to emergency preparedness and response actions
    - Software and data analysis for the received data updated periodically and to high security standards
    - The state of the monitoring and data analysis systems continuously monitored for any data gaps, connection issues or processing issues
    - Warnings generated and disseminated in an efficient and timely manner for each type of hazard
    - Warning system(s) subjected to regular system-wide tests and exercises

- Process established to verify that warnings have reached the principal stakeholders and people at risk
- Mechanisms in place to inform people when the threat and its impacts have ended
- Operational processes, including data quality and warning performance, are routinely monitored and evaluated
- Fail-safe systems in place, such as power backup, equipment redundancy and on-call personnel systems
- Strategies developed to build credibility and trust in warnings (e.g. understanding difference between forecasts and warnings)
- False alarms minimized, and improvements communicated to maintain trust in the warning system
- Warning and forecast archival processes and systems in place

3. Are there institutional mechanisms in place?

- Plans and documents for monitoring networks available and agreed upon with experts and relevant authorities
- Standardized process, and roles and responsibilities of all organizations generating and issuing warnings established and mandated by legislation or other authoritative instrument (e.g. memorandum of understanding (MOU), standard operating procedures)
- Agreements and interagency protocols established within country for exchange of monitoring systems data and baseline data needed for certain data products (e.g. bathymetric and topographic data for tsunami modelling)
- Agreements and interagency protocols established to ensure consistency of warning language and communication responsibilities where different hazards are handled by different agencies
- A multi-hazard coordination strategy established to obtain mutual efficiencies and effectiveness among different warning systems
- Warning system partners, including local authorities and the media, are aware of and respect which organizations are responsible for generation and issuance of warnings
- Cross-border exchange of warnings and observation data realized through bilateral/ multilateral agreements, especially for concerns such as tropical cyclones, floods, diseases, shared basins, data exchange, and technical capacity-building

<u>Linkages with other elements</u>

Understanding the risk profile of the country provides critical information for the other multi-hazard early warning system elements, namely:

Risk knowledge: Monitoring and forecasting data and information provide the basis for quantifying hazards and exposure to risk.

Warning dissemination and communication: Warnings are the trigger for communication mechanisms and initiate the processes for decision-making and enacting emergency plans.

Preparedness and response capabilities: Risk-informed warnings provide the necessary information for people to protect themselves and their property and start emergency response processes.

Component 3: Warning Dissemination and Communication

Communication and dissemination systems (including the development of last-mile connectivity) ensuring people and communities receive warnings in advance of impending hazard events, and facilitating national and regional coordination and information exchange

Warnings must reach those at risk. Clear messages containing simple, useful and usable information are critical to enable proper preparedness and response by organizations and communities that will help safeguard lives and livelihoods. Trust is a big part of effective risk communication. If the information source cannot be trusted, those at risk may not respond proactively to the warnings – and it takes a long time to establish trust. Regional, national and local communication systems must be pre-identified and appropriate authoritative voices established. The use of multiple communication channels is necessary to ensure as many people as possible are warned, to avoid failure of any one channel, and to reinforce the warning message.

There are numerous standards and protocols used by alerting authorities to transmit warnings. The Common Alerting Protocol is an international standard format for emergency alerting and public warning, developed by the International Telecommunication Union and promoted by several agencies. It is designed for "all-hazards", that is, hazards related to weather events, earthquakes, tsunamis, volcanoes, public health, power outages, and many other emergencies.

<u>Key Actors</u>

National and local disaster management agencies; scientific and technical agencies such as meteorological and hydrological organizations, health authorities and geophysical agencies; military and civil authorities; telecommunication organizations (e.g. national telecommunication regulators, satellite and mobile-cellular network operators), media organizations (e.g. television, radio and social media) and amateur radio; businesses in vulnerable sectors (e.g. tourism, care facilities for older people, marine vessels); community-based and grassroots organizations; international and United Nations agencies.

<u>The Checklist</u>

1. Are organizational and decision-making processes in place and operational?

- Functions, roles and responsibilities of each actor in the warning dissemination process enforced through government policy or legislation at all levels and included in the standard operating procedures
- Warning communication strategies at the national, subnational and local levels in place that ensure coordination across warning issuers and dissemination channels
- Regular coordination, planning and review meetings between the warning issuers, the media and other stakeholders
- Professional and volunteer networks established to receive and disseminate warnings widely

- Feedback mechanisms in place to verify that warnings have been received and to correct potential failures in dissemination and communication
- Mechanisms to update the information are in place and are resilient to the event

2. Are communication systems and equipment in place and operational?

- Trust between stakeholders established
- Communication and dissemination systems tailored to the different needs of specific groups (urban and rural populations, women and men, older people and youth, people with disabilities, etc.)
- Understanding of last-mile connectivity to know which population groups can be reached by different services, including mobile-cellular, satellite and radio services
- Warning communication and dissemination systems reach the entire population, including seasonal populations and those in remote locations, through multiple communication channels (e.g. satellite and mobile-cellular networks, social media, flags, sirens, bells, public address systems, door-to-door visits, community meetings)
- Communication strategies evaluated to ensure messages are reaching the population
- Agreements developed to utilize private sector resources where appropriate (e.g. mobile-cellular, satellite, television, radio broadcasting, amateur radio, social media) to disseminate warnings
- Equipment maintained and upgraded to utilize new technologies (when appropriate) to ensure interoperability
- Backup systems and processes in place in the event of failure
- Resilience of communication channels and early warning system hardware evaluated in advance to reduce the impact of events on the infrastructure
- Coverage of communication channels and multiple-channel systems assessed to identify gaps and possible points of failure that may increase vulnerability

3. Are impact-based early warnings communicated effectively to prompt action by target groups?

- Warning messages provide clear guidance to trigger reactions (e.g. evacuation)
- In the case of events with a short time-frame for reaction (e.g. earthquake early warning), automated systems should be in place to mitigate impacts (e.g. automatic stop of transport, activation of red lights in tunnels, stopping elevators on the closest floor, opening of fire-truck gates, etc.)
- Early warnings should consider the different risks and needs of subpopulations, including differential vulnerabilities (urban and rural, women and men, older people and youth, people with disabilities, etc.)
- Public and other stakeholders are aware of which authorities issue the warnings and trust their message.

Linkages with Other Elements

Understanding the risk profile of the country provides critical information for the other multi-hazard early warning system elements, namely:

Risk knowledge: Information is required on weaknesses and strengths of communication channels and on early warning system hardware resilience.

Detection, monitoring, analysis and forecasting: Agreements and interagency protocols are required to ensure authoritativeness and consistency of warning language and coherence of communication responsibilities for each hazard. Cross-border exchange of warnings and observation data should be conducted.

Preparedness and response capabilities: Inclusion of communication channels and protocols in disaster preparedness and response plans. Protocols established to reach emergency and health services that need to be ready to respond to events promptly.

Component 4: Preparedness and Response Capabilities

Institutions and people enabled to act early and respond to a warning through enhanced risk education.

It is essential that people understand their risks, respect the national warning service and know how to react to the warning messages. Education and preparedness programmes play a key role. It is also essential that disaster management plans include evacuation strategies that are well practiced and tested. People should be well informed on options for safe behaviour to reduce risks and protect their health, know available evacuation routes and safe areas and know how best to avoid damage to and loss of property.

Key Actors

National and local disaster management agencies; scientific and technical agencies such as meteorological and hydrological organizations, health authorities, ocean observing organizations and geophysical agencies; military and civil authorities; humanitarian and relief organizations (e.g. National Red Cross and Red Crescent Societies); schools; universities; informal education sector; media organizations (e.g. television, radio and social media); businesses in vulnerable sectors (e.g. tourism, care facilities for older people, marine vessels); non-governmental organizations, community-based and grassroots organizations; international and United Nations agencies

The Checklist

1. Are disaster preparedness measures, including response plans, developed and operational?

- Disaster preparedness, including plans or standard operating procedures, developed in a participatory manner, disseminated to the community, practiced and underpinned by legislation where appropriate
- Disaster preparedness measures, including plans and standard operating procedures, account for the needs of people with different degrees of vulnerability
- Multi-hazard risk assessments utilized to develop and design evacuation strategies (evacuation routes, demarcation of safe

areas and location of temporary shelters, use of vertical evacuation if needed)

- Community's ability to communicate in response to early warnings assessed
- Contingency planning developed in a scenario-based manner following forecasts or likely scenarios across different timescales and informed by climate projections and scientific research
- Early action and response options across time and geographical scales are linked to the provision of funding to support them
- Strategies implemented to maintain preparedness for longer return-periods and cascading hazard events
- Protocols incorporated in the plans or standard operating procedures to reach emergency and health services that need to be ready to respond to events promptly
- Protocols established to activate and mobilize last-mile operators (e.g. local police, firefighters, volunteers, health services) who disseminate warnings to the public and decide public measures, including issuing orders for evacuation or sheltering in place
- Regular exercises undertaken to test and optimize the effectiveness of early warning dissemination processes, preparedness and response to warnings

2. Are public awareness and education campaigns conducted?

- Ongoing public awareness and education programmes on hazards that could impact the population, vulnerabilities, exposure and how to reduce disaster impacts built into school curricula from primary through university
- Public education provided to recognize hydro-meteorological and geophysical hazard signals and disease signs and symptoms in order to contribute to community surveillance and to allow and promote robust no-regret response measures
- People educated on how warnings will be disseminated, which sources are reliable and how to respond
- Utilization of the most effective media (e.g. established broadcasting media, social networks, alternative media) to improve public awareness
- Public awareness and education campaigns tailored to the specific needs of vulnerable groups (e.g. women, children, older people and people with disabilities)

3. Is public awareness and response tested and evaluated?

- Previous emergency and disaster events and responses analysed, and lessons learned incorporated into preparedness and response plans and into capacity-building strategies
- Public awareness strategies and programmes evaluated regularly and updated as required.

<u>Linkages with Other Elements</u>

Understanding the risk profile of the country provides critical information for the other multi-hazard early warning system elements, namely:

Risk knowledge: Feedback from lessons learned and exercises to test and optimize the effectiveness of the early warning system should be considered/incorporated when developing risk assessments.

Detection, monitoring, analysis and forecasting: Feedback from lessons learned and exercises to test and optimize the effectiveness of the early warning system should be considered when developing/improving warning messages and operational forecasting processes.

Warning dissemination and communication: Feedback from lessons learned and exercises to test and optimize the effectiveness of the early warning system should be considered when developing/improving communication dissemination agreements and protocols among agencies, institutions and the public.

Table 1: **Criteria development matrix: Criteria and indicators of the condition of EWS in cities (Modified after TARU (2014))**

S. NO.	General /overlapping indicators	EWS GOVERNANCE - CITY LEVEL INSTITUTIONAL FRAMEWORK				
	CRITERIA	DEVELOPMENT STAGE INDICATORS				
		1	2	3	4	5
1	State legislation for EWS framework includes local authority (Urban Local Body) as an integral part **(document, control to the ULB)**	Not envisaged	Need is realized, changes in legislation are in process	In place, but not implemented	In place, partially implemented	In place and implemented
2	Institutional mechanism for Local Authority (ULB) is an integral part of EWS framework **(document, mandate, implementation)**	Not envisaged	Need is realized, changes in institutional mechanism are being brought about	In place, but mandate remains unclear	In place, but partially implemented	In place and implemented

3	ULB accorded with the authority to disseminate warnings **(mandate, SOP, implementation)**	Not envisaged	Mandate does not exist, but informal dissemination happens	Mandate exists for dissemination with no SOP in place	Mandate and SOPs in place, implementation not effective	Mandate and SOP in place with effective implementation
4	Extent of preparedness and prevention actions evident among state technical and disaster management agencies **(relevant department DM Plan at state, SOPs, link from state to city)**	Select departments have DM Plan, but it is not implemented	All departments have DM Plan, partially implemented	All departments have DM Plan and SOP in place and implemented, but not integrated across	All departments have DM Plan, SOP in place, implemented and integrated across state departments	All departments have DM Plan, SOP in place, implemented, integrated across state departments and with links to the city

S. NO.	COMPONENT 1	RISK KNOWLEDGE				
	CRITERIA	DEVELOPMENT STAGE INDICATORS				
		1	2	3	4	5
1.1	Hotspots identified for potential hazard impact (identified, mapped and updated)	Hotspots not identified	Hotspots vaguely identified through past incidence records, not demarcated	Hotspots identified and mapped across city for selected hazards	Hotspots identified and mapped across the city for all hazards, not updated at regular intervals	Hotspots identified and zone of demarcation updated on regular intervals
1.2	Vulnerability, exposure and Risk assessment carried out and integrated with potential impact assessment.	Risk assessment does not exist	Risk prone areas identified based on historical data, past disasters and other qualitative information in the form of institutional memory and tabular records	Risk assessment undertaken with technical information and demarcates risk prone administrative units, risk assessment products available in the form of maps and quantitative information	Risk assessment (hazard maps, vulnerability and risk maps) available on GIS platform but not updated periodically and not fully integrated with prediction component to derive potential impact assessment and stage response	Risk assessment updated periodically (available on GIS platform) and fully integrated with prediction component to derive potential impact assessment and stage focused response
1.3	Seasonality of disaster not known	Aware of seasonality but not documented	Documented but not as a part of DM Plan	Information about seasonality available but not included a seasonality charting	Seasonality Charting is been made as a part of Disaster Management Plan	Seasonality Charting is been made as a part of Disaster Management Plan and is integrated with EWS and response plans
1.4	Historical and Indigenous knowledge available in the community (what, where, when, what to do etc.)	Historical/Indigenous knowledge not existing	Historical/Indigenous knowledge not documented	Historical/Indigenous knowledge not documented but not included in the HRVA studies	Historical/Indigenous knowledge is used in HRVA as well as reflected in DM Plans	Historical/Indigenous knowledge integrated with scientific knowledge in EWS.
1.5	Climate Risk Assessment and knowledge	Climate Risk Assessment not done at state or district level	Climate risk not done using models and Geo-informatics tools	Climate Risk Assessment done, and State Action Plan is Based on the assessment	Climate Risk Assessments / projections made as a part of DM Plan	Climate Risk Assessments used in designing of EWS.
1.6	State legislation for EWS framework includes local authority (urban local body) to carry out HRVA	State legislation not including EWS	State legislation not including EWS and role of local authority	Role of authority in EWS is clear but not involved in HRVA	Role of authority in EWS is clear and involved in HRVA	Local authority involved in HRVA and preparation of City DM plan

S. NO.	COMPONENT 2	FORECASTING AND WARNING SYSTEMS				
	CRITERIA	DEVELOPMENT STAGE INDICATORS				
		1	2	3	4	5
TECHNICAL AGENCIES						
2.1.1	Monitoring & Forecasting mechanism for geophysical hazards (earthquake)	Forecasting and Warning mechanism does not exist	Forecasting and Warning exists with no consistency in Forecasting and Warning message and inadequate respite time	Consistency in Forecasting and Warning message with inadequate respite time	Consistency in Forecasting and Warning message with adequate respite time	Advanced Forecasting and Warning protocol with adequate respite time (with multiple relay and deactivation process)
2.1.2	Monitoring, Forecasting & Warning mechanism for geophysical hazards (Landslide)	Forecasting and Warning mechanism does not exist	Forecasting and Warning exists with no consistency in Forecasting and Warning message and inadequate respite time	Consistency in Forecasting and Warning message with inadequate respite time	Consistency in Forecasting and Warning message with adequate respite time	Advanced Forecasting and Warning protocol with adequate respite time (with multiple relay and deactivation process)
2.1.3	Forecasting monitoring and Warning for hydro-meteorological hazards (severe wind, extreme rainfall, flooding)	Forecasting and Warning mechanism does not exist	Forecasting and Warning exists with no consistency in Forecasting and Warning message and inadequate respite time	Consistency in Forecasting and Warning message with inadequate respite time	Consistency in Forecasting and Warning message with adequate respite time	Advanced Forecasting and Warning protocol with adequate respite time (with multiple relay and deactivation process)
2.2	Availability of technology in nowcast/ forecast of hydro-meteorological hazards by technical agencies	High dependency on national agencies for observation, monitoring and forecasting	Has sufficient technology to observe, monitor and nowcast/forecast at regional level, with high dependency on technology available at regional centres	Has sufficient technology to observe, monitor and nowcast/ forecast at district level	Has sufficient technology to observe, monitor and nowcast/ forecast at city level	Has sufficient technology to observe, monitor and nowcast/ forecast at community level/hotspots
2.3.1	Forecasting and Warning mechanism for public health risks: Vector borne diseases, Water borne diseases and other communicable diseases	Advisory does not exist	General advisory exists with no indication of areas and vulnerable groups	Advisory exists for vulnerable groups with no demarcation of areas	Demarcation of areas based on active and passive surveillance with time delay, no involvement of private stakeholders	Near real time warning, protocol established, active and passive surveillance along with involvement of private stakeholders

S. NO.	COMPONENT 2	FORECASTING AND WARNING SYSTEMS				
	CRITERIA	DEVELOPMENT STAGE INDICATORS				
		1	2	3	4	5
2.3.2	Disease surveillance system (surveillance coverage, collection method, analysis)	Surveillance exists at district level using paper-based forms; analysis undertaken at district level	Surveillance exists at city level within government hospitals using paper-based forms; analysis undertaken at city level	Surveillance exists at city level within government hospitals, private hospitals and all clinics; using paper-based forms; analysis undertaken at city level	Surveillance exists at city level within government hospitals, private hospitals and all clinics; using computerized data collection; analysis and mapping undertaken at community level	Detailed surveillance is carried out on a near real time basis, disease forecast information is made available for decision making
2.4.1	Uncertainty in forecast and warning: Hydro-meteorological hazards	Forecast/warning does not exist	Forecast exists with high uncertainty, and no warning exists	Forecast exists with high uncertainty, followed by incomprehensible warning	Warning based on forecast exists, with medium degree of uncertainty	Warning based on forecast exists, with low degree of uncertainty
2.4.2	Uncertainty in forecast and warning: Geophysical hazards	Forecast/warning does not exist	Forecast exists with high uncertainty, and no warning exists	Forecast exists with high uncertainty, followed by incomprehensible warning	Warning based on forecast exists, with medium degree of uncertainty	Warning based on forecast exists, with low degree of uncertainty
2.5	Multi-hazard coordination strategy established	No coordination between states exists	IMD share data on meteorological and seismological hazards	IMD share data on meteorological and seismological hazards which are used by other agencies	Multi-hazard coordination Exists but not effective	Multi-hazard coordination Exists and is effective

S. NO.	COMPONENT 3	EARLY WARNING AND DISSEMINATION				
	CRITERIA	DEVELOPMENT STAGE INDICATORS				
		1	2	3	4	5
3.1	Existence of dedicated EOC at city level for disaster management	No emergency operation centres existing	There is a control room for multiple purpose, but disaster management is not a function	Multipurpose control room coordinates with other agencies and functions as EoC with in city during disasters	A dedicated EOC for Disasters set up but not fully functional	Fully functional EOC with equipment and staff existing
3.2	Budget allocation by the local authority for EWS	Budget head doesn't exist	Budget head doesn't exist, currently being spent from miscellaneous heads	Need for DM budget head realized, plan to incorporate budget for Disaster Management	Budget exists for DM, no specific budget heads exists for EWS	Budget exists for DM, specific sub-head for EWS exists
3.3	Data availability for operations of EWS	Data available with different agencies in multiple formats, not collated or aggregated, qualitative information available	Data is collated from different departments, partial digitization undertaken but not updated regularly; currently not in usable format	Data is collated and updated regularly, limited quality assurance and quality control, temporal data available, spatial data not available, data is of limited use	Data is collated and updated regularly, quality assurance and quality control, temporal and spatial data available, data available in limited usable format	Standardized spatial and temporal data are collated and updated regularly for city EWS, single window system exists for data updation and dissemination, data available in usable format
3.4	Staffing and capacity within local authority for operation and maintenance of EWS	No dedicated staff for EWS	Staff deputed on need basis, not specifically trained for operating EWS	Manpower hired on short-term basis, limited training and capacity building provided	Staff assigned for EWS but with multiple responsibility (other than EWS), limited training and capacity building provided	Dedicated specialized staff assigned for city EWS, training and capacity building of staff conducted at regular intervals
3.5	Use of modern technology to disseminate warnings	Generic media – newspapers, local cable channel and radio	In addition to generic media, public addressable system (PAS) in place, but limited to siren	In addition to generic media, PAS in place, but limited to siren and digital display at select locations	Fixed and vehicle mounted PAS, digital/ electronic display screen at select locations, mobile (SMS), web, community radio	State-of-art alert and warning system, dedicated channel, online dissemination system
3.6	Redundancy (multi-mode) in communication networks	None	Recognition of need, no special arrangements made	Recognition of the need and development in process	Warning system reflects the arrangement, partially developed, but scope for considerable improvement	Well-developed redundancy in communication network

S. NO.	COMPONENT 3	EARLY WARNING AND DISSEMINATION				
	CRITERIA	DEVELOPMENT STAGE INDICATORS				
		1	2	3	4	5
3.7	Timely dissemination of warnings to vulnerable groups (residing in slums, high risk prone areas)	No specific warning for vulnerable groups exists in the city	Dissemination of warning exists to some extent	Dissemination of warning exists for select hazards, but with limited respite time	Dissemination of warning exists for all hazards, but with limited respite time	Dissemination of warning exists, with enough respite time
3.8	Arrangement for night-time warning (floods & landslides)	No specific arrangement for warning in night time	Recognition of the need, planning in progress	Night-time warning is recognized, and arrangements reflect this, scope for considerable improvement in dissemination/ outreach	Night-time warning dissemination and outreach established	Warning dissemination tested through conduct of emergency night-time drills/event
3.9	Media engagement in dissemination of warning	Limited coverage, media collects information from respective agencies, shortcomings in communication	Limited coverage of information from respective agencies, technical information presented as received from agencies, shortcomings in communication, problem recognized but not addressed	Media collects and disseminates information, shortcomings are being addressed through collaboration with agencies	Media collects information from technical agencies, timely dissemination of warning to citizens in an understandable format (authenticated value addition)	Standardized content with graphical/iconic representation, near real time updates, citing possible impacts
3.10	Content of warning to general public by local government (ULB) (graphical representation and behavioural content for taking actions at individual/household and community levels)	Limited information	Adequate information for select hazards, but with no behavioural content	Adequate information for relevant hazards, but with no behavioural content	Warning information with graphical, factual representation and general behavioural content at city level	Warning information with graphical, factual representation at ward level and contextual behavioural information provided
3.11	Risk communication	Risk assessment does not exist, hence no communication	Risk not assessed in local context, information generated by technical agencies are transferred and published/disseminated	Risk is assessed in local context and communicated to select stakeholders	Risk communication including preparedness measures are communicated to stakeholders, dissemination is not robust (last mile connectivity is not ensured)	Well-established risk communication mechanism enables stakeholders to manage risk, dissemination is robust (last mile connectivity is ensured)

S. NO.	COMPONENT 3	EARLY WARNING AND DISSEMINATION				
	CRITERIA	DEVELOPMENT STAGE INDICATORS				
		1	2	3	4	5
3.12	Raising awareness about warnings at city level	No efforts are being made to sensitize citizens	Efforts are made to raise public awareness on frequent hazards, need basis	Awareness programmes on frequent hazards and their risks are conducted on regular/seasonal intervals, special population needs are also not addressed and programme not evaluated	Comprehensive programmes on all hazards and their risks are conducted on regular basis, special population needs addressed, but programme not evaluated	Comprehensive programmes on all hazards and their risks are conducted to raise the level of public awareness, programme regularly evaluated and strengthened

S. NO.	COMPONENT 4	RESPONSE CAPABILITY				
	CRITERIA	DEVELOPMENT STAGE INDICATORS				
		1	2	3	4	5
5.1	Response Plans are in place and well tested and being updated regularly	No response plan existing	Response plan made as a part of the City DMP	Response plan used in few disasters	Response plan is available and used for all disasters	Response plan is regularly updated
5.2	Extent of coordination between technical agencies and disaster management agencies	Communication is limited to select agencies	Communication with all agencies exist, coordination does not exist	Communication with all agencies exist, limited coordination exists	Coordination mechanism ensures agencies respond to specific needs	Coordination ensures collective decision making
5.3	Extent of links between disaster management agencies and service providers	No formal links exist, service providers depend on information hosted on public domain	Formal links do not exist, select service providers are informed during the onset of an event	Formal links become active only prior to/ during an event	Formal links become active periodically in anticipation of an event, one-way communication initiated from disaster management agency	Formal links become active periodically in anticipation of an event, two-way communication established to ensure business continuity, co-benefit achieved
5.4	Extent of links between media and disaster management agencies	Media depend on information hosted on public domain	Limited information is provided to media	Collaboration and reflection of warning information in the media products are evident	Active collaboration exists, understanding of warnings are reinforced through discussions, no value addition	Well-developed links exist, seamless flow of information, value addition to warning is evident

S. NO.	COMPONENT 4	RESPONSE CAPABILITY				
	CRITERIA	DEVELOPMENT STAGE INDICATORS				
		1	2	3	4	5
5.5	Mock drill is been carried out regularly	No mock-drill	Mock drill only for Earthquake and fire but no regularity	Mock drills are been conducted for few hazards but regularly and reports are been prepared	Mock drills conducted of all the major hazards and disasters in the city and reports are prepared	Observations/ suggestions from the mock drill integrated in the DM plan
5.6	Resources are available, and inventory is prepared systematically	Resources are available but limited	Resources and available but not inventoried systematically	Resources with most of the departments are made as annexure in the DM plan and included in IDRN	IDRN database is up to date with all the skilled human resource, critical supply and equipment and is been used for response	Geo-referenced resource inventory is available and used effectively.
5.7	Capacity building of response agencies including NGOS	No provision for capacity development	Provision of capacity development and funds are available	Capacity development programmes are been done but not adequately	Capacity development programmes based on needs done regularly	Evaluation of the trainings and improvement in skills of being done and the capacity development initiatives are amended accordingly
5.7	Extent to which the warning mechanism allows for feedback from affected area	No feedback mechanism exists	Problem recognized and mechanism under development	Feedback mechanism exists, but does not include all stakeholders	Feedback mechanism includes all stakeholders, but is not robust	Feedback mechanism functions in near real time
5.8	Monitoring, evaluation and targets for improvement of EWS	No formal procedure to monitor the EWS performance is in place	Need realized, M&E process is under development	Monitoring of select EWS components are in place, improvement needed	M&E process is in place, not undertaken at regular intervals	M&E process is in place and is being carried out regularly, targets for improvements are outlined

5. City Profile

5.1 Geography

Shimla is often referred as “Queen of the Hills” and located in the middle ranges of the

Himalayas. In the year 1864, Shimla was declared the summer capital of the British Raj in India. Located in the north-west Himalayas at an average altitude of 2,205 metres (7,234 ft) above the sea level and lies between 31o 06’ North to 77o 13’ East. The high altitude has a fitting vegetation cover of evergreen pine trees. The city is spread over an area of 25 square kilometres. Though it seems small, the hills and undulating terrain surrounding it give it the look of a majestic hill station. The city is famous for its British architecture dating from the colonial era. The city is spread on a ridge and its seven spurs and stretches nearly 9.2 km from east to west.

5.2 Climate

Shimla in general has a mild highland climate, with temperature in peak winters, falling below 0°C. Shimla features a subtropical highland climate under the Koppen climate classification. The climate in Shimla is predominantly cool during winters and moderately warm during summers. The temperatures range from -4°C (24.8°F) to 31°C (87.8°F) over the year. The average temperature during summer is between 19°C and 28°C and between -1°C and 10°C in winter. Monthly precipitation varies between 24 mm. in November to 415 mm. in July. It is typically around 45 mm. per month during winter and spring and around 115 mm in June as the monsoon approaches. The average total annual precipitation is 1520 mm (62 inches). Snowfall in the region, which historically has taken place in the month of December, has lately (over the last fifteen years) been happening in January or early February every year. In the year 2017 heavy snow fall in January the resulted in huge disruption of services and critical supplies including water, electricity and telephone services for more than a week.

6. Hazard Scenario in Shimla City

The city is prone to multiple hazards and disasters of geophysical, hydro-meteorological, biological and anthropogenic origin.

6.1 Geophysical Hazards

6.1.1 Earthquake

Shimla and its surrounding region are bounded by two major thrusts, the Main Central Thrust (MCT) and Main Boundary Fault (MBF). Other thrusts in the region which include Jwalamukhi Thrust and the Drag Thrust, result in several other lineaments piercing the zone into fractured and faulted blocks and active faults, enhancing the structural discontinuities. The city of Shimla falls in Zone IV (High Damage Risk Zone) as per the seismic hazard zoning map of India. The region has experienced frequent mild

tremors and periodic major earthquakes, and this will continue to do so in the future due to its unique tectonic setting. Weak construction techniques and increasing population pose a serious threat to the already earthquake prone region.

Earthquake induced ground failure can be expected along the northern slopes of the ridge, i.e., in Lakkar Bazaar, New Shimla and Vikas Nagar, Ruldu Bhatta, Phingask, KachhiGhhati (soft valley), and along the drainage channels. Northern slopes (Snowdown Hospital Area) of the Ridge have already experienced subsidence since 1971 and are still considered as 'sinking zone' extending from Scandal Point to Lakkar Bazaar, including the Old City Bus Stand, Idgah, Longwood, Ruldu Bhatta and adjoining areas. Soft soil depth is about 10 m at some places in New Shimla, which may also lead to subsidence in the face of an earthquake (Anshu Sharma, Reducing Urban Risk through Community-Based Approaches in Shimla; CDMP Shimla 2012).

Seismic hazard of Shimla city shows that eastern part of the city is less hazardous compared to the western part. Seismic activity may not be generated within the city's proximity; however, the Himalayan seismic activity will affect the city. Shimla can expect maximum peak ground acceleration (PGA) of 4.0 meters per Second Square. This suggests that Shimla can expect an earthquake of seismic intensity of VIII on the Modified Mercalli (MM) Intensity Scale. MM VIII indicates that there can be slight damage in specially designed structures; considerable in ordinary substantial buildings; and great damage in poorly built structures. Panel Walls can be thrown out of frame structures. Chimneys, factory stacks, columns, walls and monuments can collapse. Heavy furniture can get overturned. Sand and mud can get ejected in small amounts. Changes can be caused in water levels. Most of the structures in Shimla fall in the 'poor built' classification. Earthquake induced ground failure can be expected along the northern slopes of the ridge, i.e. in Lakkar Bazar, New Shimla and Vikas Nagar, Ruldu Bhatha.

6.1.2 Landslides

The landslide hazard analysis of Shimla shows that large parts of the city are under moderate to high hazard conditions. While saying this, there are ample signatures of engineering solutions present in the city and its surroundings which point towards the fact that the vulnerability of the area has been identified earlier also and likewise and attempts were made to provide. In most critical slopes of the area retaining walls, cascades have been erected, at most of the places and these are aided with weep holes for transfer of water from higher elevations to the lower elevations without affecting the slopes. Inceptor drains are also ample in the area. However, the interceptor drains are not always properly managed and are in many cases filled with soil, rotting foliage and most alarmingly, plastic which retard and prevent safe carriage of intercepted water. In many places the weep holes have been carelessly stuffed with plastic bottles,

which are introducing dampness to the slopes and increasing the degree of hazard.

The state capital Shimla is also sinking at several places due to digging of slopes for construction and infrastructure development. Recent geological studies indicate that roughly 25% of the old town is in the sinking zone, and unless improvements are made in the drainage and sewerage systems of the upper reaches, more could go under. Geologists say that Though it has compacted over the years, many parts of Lakkar Bazar and Rivoli bus stand do show a downward creeping movement. Slopes have become overloaded, and buildings in several heavily crowded localities in the central part of the town have become unsafe as they fall in the sinking zone. When the famous Ridge of Shimla was constructed, the hilltop was sliced, and all the debris was dumped on its northern slopes. First major landslide occurred in Shimla in February 1971 when a large northern portion of the Ridge slumped down threatening the safety of reservoirs below. Since then many areas of the town have become prone to landslides and situation worsens during rainy season when vulnerable roads are washed away at many places as frequent number of landslides that often take place after heavy rains. The other reasons for these slides are faulty building construction practices along these slopes. The city is prone to frequent landslides with majority of the events taking place during the monsoons. Rainfall triggers instability of the slopes, especially after a heavy downpour, and the resulting landslide events.

6.2 Hydro-meteorological Disasters

Reports mention that severe storms, lightning and severe winds have in the past caused damage to the city and its infrastructure. Every year severe storms, lighting and high winds cause huge loss to the economy of Shimla City. It results into tree falling, damage to electricity supply wires, telephone cables, street lights, etc. Due to tree falling much time it causes loss to life, buildings or vehicles. As per the BMTPC wind hazard zone map of Himachal Pradesh it is visible that Shimla lies in moderate damage risk zone. Winds are generally light throughout the year. The frequent risk includes falling of trees and subsequent blocking of the road network and tripping of electricity and communication networks.

The extreme short-lived events cause severe downpour and wash away all obstacles in the path resulting in loss of lives and severe damage to property. Though there is no recorded history of cloudburst in Shimla City but the vulnerability of the town to this hazard cannot be ruled out. Snowfall usually occurs between December and February.

6.3 Urban Heat effect:

In Lower bazar, Bharari, Chamiyana, Tutikandi and Nabha ward, the variation between land surface temperature as observed in thermal image was < 2 degree Celsius (TARU City level analysis, 2016). Various activities in the city do contribute to formation of heat islands within the city. During the summer, the city of Shimla is used to a moderate rise in the temperature. However, the houses are not equipped with the fans or air conditioners. So, the effect of higher temperature will accentuate the warm conditions and the same temperature will feel like it is hotter. Ongoing building construction also use glass as a main building material to let more light and heat inside along with reflecting sunlight onto the surroundings. However, this heat that is trapped inside creates uncomfortable conditions indoor. This situation coupled with the rise in summer temperature may cause heatwave conditions in the city.

6.4 Public Health Risks

Rapid urbanization, industrialization, developmental activities, ecological changes as well as international travel have increased the risk of transmission of diseases. Similarly, changes in lifestyle are accompanied by increased risk of certain non-communicable diseases. Alternatively, inadequate drinking water facilities and poor sanitary conditions pose risk of communicable diseases. The residents of Shimla are affected by frequent water-borne disease (e.g. Jaundice) outbreaks. These outbreaks may be a result of sewage mixing with potable water or contamination of natural water sources. IT also reports cases of acute diarrhoeal disease (cholera), scrub typhus, enteric fever, fever of unknown origin, acute respiratory infection, bacillary dysentery and measles. The Health Department of SMC and the IDSP Cell undertake IEC activities regarding safe drinking water, hygienic practices and sanitation measures.

6.5 Fire Hazards

6.5.1 Urban Household Fire

There have been many incidents of fire in the city of Shimla. One main reason for these fires to spread and cause huge damages is the nearness of the houses or shops. Many a times, these fires were observed in the densely packed shopping area in Lower Bazar (January 9, 2016 at 3.00am). Some of the well-known fire accidents within Shimla city are: Lower Bazar fire of 9 January 2016; AG Building (Gorton Castle, January 28, 2014); Deepak project fire (Minto Court near Indian Institute of Advance Studies, November 2, 2014). While the losses in these accidents run into crores of rupees, the heritage and architectural loss is irreplaceable. From the primary survey, 28% of the households have experienced some form of fire accidents, but many of them did not face any losses. The survey respondents have memory of 12 incidents at the neighbour level which caused losses within the city – right from

1947 to 2015. Out of the sampled households, there are 16 houses which are having exposed fire in the kitchens, while rest of the households use non-exposed fires, like induction, microwave and other kitchen utilities. The vulnerability of the households in terms of fire is still high, from the point of view of access to fire services. The topic is explained in section (Taru, 2016).

6.5.2 Forest Fire

The forests of western Himalayas are more vulnerable to forest fires as compared to those in eastern Himalayas. Frequency and intensity of forest fires has increased since 1990 in Himalayan region. Forest fires are an annual phenomenon in state of Himachal Pradesh. This is a most frequent hazard. Fire season starts from mid-April, when there is no rain for months, forests become littered with dry senescent leaves and twinges, which could burst into flames or ignited by the slightest spark. In June 2007, forest fire destroyed 2,000 hectares of forest in Himachal Pradesh (SAARC-DM Centre, 2007). The district of Shimla has experienced around 29 events of fires in the last decade. Forest fires are mostly anthropogenic in nature in Himachal Pradesh and may occur due to the following reasons like Forest floor are often burnt by villagers to get a good growth of grass in the following season or for a good growth of mushrooms, Wild grass or undergrowth is burnt to search for animals, firing by miscreants, attempt to destroy stumps of illicit fallings.

6.5.3 Water shortage

Water supply system of Shimla was initially established in the year 1875 to serve a population of 16,000. It was designed to pump water from the nearby stream with the help of engineering structures. Today, water supply is one of the major impediments in the growth and development of Shimla. It is the joint responsibility of Irrigation and Public Health Department (I&PH) and Municipal Corporation Shimla (MCS) to supply drinking water to the population. Whereas, the I&PH department is responsible for the planning and distribution of bulk water in the city, operation and maintenance of water supply infrastructure, billing, collection of user charges and penalties for domestic as well as commercial connections are under the jurisdiction of MCS. The water supply system in Shimla was introduced in 1875 by the British with 4.45 MLD capacity. To mitigate the increased water requirement of city dwellers, Shimla had five water augmentation schemes, 3 before independence and 2 after independence. The last augmentation scheme for the city was commissioned in the year 1992. Shimla depends on 6 water sources for its daily water needs. As per records of the Department of Irrigation and Public Health, in lean period availability of water supply to the city is 12.38 mld, whereas 30.60 mld during non-lean period. The installed capacity of water supply system is 47.40 mld against present availability of water intake sources of 39.21 mld. Cost of water supply is Rs. 28 per 1000 litres. The

water supply is inadequate to city residents as well as Planning Area population due to rapid growth of population. Presently, as per 2011 Census, 1,74,789 persons are residing in Planning Area, which has been anticipated to increase to about 3, 18,560 persons for the year 2021. Existing water supply is not enough to rural settlements and water for these settlements is managed through local natural sources i.e. 'Baulies', springs and nallah's which have also been tapped for various Government water.

supply schemes. In the year 2018, during summer months Shimla experienced severe water shortage due to failure of the distribution systems. The projected climatic changes couples with tourism and water use and management practices in likely to have serious negative implication for the city.

7. End to End Early Warning System in Shimla - Comparison of the Indicators of EWS (2014 Vs 2018)

In the 2014 while the previous review of EWS was carried out, WMO has not come up with a check list in lines to the UNISDR methodology. UNISDR methodology has been widely accepted and been used for monitoring the progress achieved under the Target G i.e. substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030. Since the analysis was focussed on the progress made since 2014, instead of selecting indicators directly from WMO check list, rearrangement of indicators used in the 2014 study has been attempted. Also the general indicators are overlapping in nature and not pertaining to any one component of the EWS. Methodology followed is similar to the previous analysis carried out in 2014. Main addition is the household survey and First step was to develop criteria development matrix and this step was followed by Key Informant Interview of officials and staff working the concerned department. Besides experts informal interview cum interaction of people living in the area was also attempted. House hold survey was also carried out to understand the effectiveness at user level and the details are given in section 8.

General Indicators of EWS and City Level Institutional Framework

S. NO.	General	YEAR	EWS GOVERNANCE - CITY LEVEL INSTITUTIONAL FRAMEWORK					
	CRITERIA		DEVELOPMENT STAGE INDICATORS					Description
			1	2	3	4	5	
1.1	State legislation for EWS framework includes local authority (urban local body) as an integral part (document, control ULB)	2014	●					The State Disaster Management (DM) Plan has no mention of role/mandate for Shimla Municipal Corporation as a part of the EWS framework. This constrains the development of EWS at the city level. The legal status of EWS establishment at the city level is unclear
		2018			●			The State Disaster Management (DM) Plan 2017 included the role/mandate of Urban Local bodies in Risk Assessments, Mitigation, preparedness, capacity development, disaster response as well as mainstreaming DRR.

S. NO.	General	YEAR	EWS GOVERNANCE - CITY LEVEL INSTITUTIONAL FRAMEWORK					
	CRITERIA		DEVELOPMENT STAGE INDICATORS					Description
1.2	Institutional mechanism for local authority (ULB) is an integral part of EWS framework	2014	●					The Shimla City DM Plan 2012 has mention of EWS; however, it does not indicate any institutional mechanism and the role of Shimla Municipal Corporation (SMC) as part of the EWS framework
		2018			◐			The Shimla City DM Plan 2016 has mention of EWS; It clearly indicates the institutional mechanism and the role of Shimla Municipal Corporation (SMC) as part of the EWS framework.
1.3	ULB accorded with the authority to disseminate warnings (mandate, SOP, implementation)	2014			●			Dissemination of warnings is done by SMC Health Department to the city via local newspaper. No SOP is currently in place
		2018			◐			Municipal Authority is mandated to make announcements regarding water shortage, power problems and other chronic stress issues. Neither SDMP, DDMP or CDMP is mandating or authorising the municipal authority
1.4	Extent of preparedness and prevention actions evident among state technical and disaster management agencies (relevant depart.DM Plan at state, SOPs, link from state to city)	2014		●				DM plans exist but are partially implemented. Preparedness actions are evident for earthquake hazard and public health risks
		2018			◐			Updated DM Plans are existing at city level (2016), district level (2017) as well as state level (2017). Extent of preparedness and preventive actions for hydro met disasters including floods and extreme weather events has been increased. Preparedness actions including mock drills for Earthquakes and fire are been carried out regularly.

Component 1 – Risk Knowledge

S. NO.	COMPONENT 1	YEAR	EWS GOVERNANCE - CITY LEVEL INSTITUTIONAL FRAMEWORK					
	CRITERIA		DEVELOPMENT STAGE INDICATORS					Description
			1	2	3	4	5	
1.1	Hazards and related threats are identified with magnitude, frequency and location (identified, mapped and updated)	2014		●				Institutional memory of hotspots exists based on historical events. This is evident for landslide prone areas, snowfall and public health risks (areas with poor access to water and sanitation services). The hotspots are not clearly demarcated.
		2018				●		Institutional memory of hotspots exists based on historical events. Hotspots for Landslides, forest fire and public health risks including the areas of poor access to water and sanitation are been mapped at city level.
1.2	Vulnerability, exposure and Risk assessment carried out and integrated with po-tential impact assessment.	2014		●				City level risk assessment has not been undertaken, qualitative ward level hazard indication is provided within the City DM Plan.
		2018				●		HRVA study has be carried out at the city level (2016) and for the entire state at district level (2016).
1.3	Seasonality of disasters is known	2014			●			Not included in the previous analysis. However the city disaster management plan and district DM Plan is having seasonality chart.
		2018			●			Seasonality charting of disasters is been carried out at district level. People are aware of the seasonality of floods, wind hazards etc. How ever climatic variation and changes are posing new challenges
1.4	Historical and Indigenous knowledge available in the	2014			●			Not included in the previous analysis.

S. NO.	COMPONENT 1	YEAR	EWS GOVERNANCE - CITY LEVEL INSTITUTIONAL FRAMEWORK					
	CRITERIA		DEVELOPMENT STAGE INDICATORS					Description
	community (what, where, when, what to do etc.)	2018			●			Traditional knowledge is there regarding time of the year and how to deal with it. However, people living in apartments and migrant population not having this kind of knowledge.
1.5	Climate Risk Assessment and knowledge	2014		●				Not included in the previous analysis. SAPCC was prepared, but detailed vulnerability and sector specific assessments was not there.
		2018			●			SAPCC already prepared and climate change and resultant risk due to extreme weather events is been assessed at district level under GIZ supported vulnerability analysis for water sector.
1.6	State legislation for EWS framework includes local authority (urban local body) to carry out HRVA	2014	●					City level HRVA was not been carried out before 2014
		2018	●					Although HRVA carried out at city level in the year 2016, Shimla Municipal Corporation officials are not aware of the existence of HRVA.
1.7	City Emergency Operations Centre (EOC) for housing data of hazard, vulnerability and risk	2014	●					There was no HRVA at city level before 2015.
		2018		●				Comprehensive City Level Multi-Hazard Risk Assessment has been carried out for Shimla however the EOC at city is not hosting the same. Assessment is still with District DM Authorities.

Component 2 – Monitoring and Forecasting

S. NO.	COMPONENT 2	YEAR	EWS GOVERNANCE - CITY LEVEL INSTITUTIONAL FRAMEWORK					
	CRITERIA		DEVELOPMENT STAGE INDICATORS					Description
			1	2	3	4	5	

S. NO.	COMPONENT 2	YEAR	EWS GOVERNANCE - CITY LEVEL INSTITUTIONAL FRAMEWORK					
	CRITERIA		DEVELOPMENT STAGE INDICATORS					Description
2.1.1	Monitoring & Forecasting mechanism for geophysical hazards (earthquake)	**2014**		●				The city of Shimla does not have geophysical early warning/alert system.
		2018		◐				The city of Shimla does not have geophysical early warning/alert system yet.
2.1.2	Monitoring, Forecasting & Warning mechanism for geophysical hazards (Landslide)	**2014**		●				The city is highly prone to landslide, but there is currently no mechanism to monitor and arrive at thresholds for landslide events within the city limits. There is high dependency on national agencies for observing, monitoring and forecasting
		2018			◐			Dependency on national agencies for observing, monitoring and forecasting is still existing. Department of Geology and Mines monitor landslides and forecasting for landslides not available for making timely decision by the authorities.
2.1.3	Forecasting monitoring and warning for hydro-meteorological hazards (severe wind, extreme rainfall, flooding)	**2014**			●			Technology to forecast and now-cast is being implemented by IMD.
		2018				◐		Improvements in technology has been made in last 3 years. Forecast is been issues 5 days in advance. Doppler weather radars systems for now-casting will be setup shortly
2.2.	Availability of technology in now-cast/forecast of hydro-meteorological hazards by technical agencies	**2014**		●				Technology to forecast and nowcast is being implemented by IMD. But the Doppler weather station in Patiala is not covering Shimla and hence now casting is not feasible.
		2018			◐			Doppler weather stations will be setup soon. Forecasting capability has been improved marginally.
2.3.1	Advisory mechanism for public health risks (vector-borne and water-borne diseases)	**2014**		●				Health surveillance at district level is being carried out by IDSP, and at city level is being carried out by Health Department, Shimla Municipal Corporation.
		2018			◐			Health surveillance at district level is being carried out by IDSP, and at city level is being carried out by Health Department, Shimla Municipal Corporation. Compared to previous years there are improvements in the disease surveillance mechanism.
2.3.2		**2014**			●			Information is collected on paper-based forms. Technology to address city-specific needs is currently limited.

S. NO.	COMPONENT 2	YEAR	EWS GOVERNANCE - CITY LEVEL INSTITUTIONAL FRAMEWORK					
	CRITERIA		DEVELOPMENT STAGE INDICATORS					Description
	Disease surveillance system (surveillance coverage, collection method, analysis)	**2018**				●		Information is been collected from ward level councillors including media and not only in
2.4.1	Uncertainty in forecast and warning (hydro-met)	**2014**	●					For hydro-meteorological hazards forecast is provided by IMD to select government institutions and media. Warning based on forecast requires improvement.
		2018		●				For hydro-meteorological hazards forecast is provided by IMD to select government institutions and media. Warning based on forecast requires lead time and as of now the time is not adequate. Extended and long-range forecasting mechanisms are yet to be in place.
2.4.2	Uncertainty in forecast and warning (Geophysical)	**2014**	●					There exists no forecast or warning mechanism for geophysical hazards.
		2018		●				There exists no forecast or warning mechanism for geophysical hazards. However, few initiatives for Landslides started in recent times.
2.4.3	Uncertainty in forecast and warning (public health)	**2014**	●					Health department has no forecast mechanism, but provides warning upon realization of the outbreak
		2018	●					Health department has no forecast mechanism but provides warning upon realization of the out-break.
2.5	Multi-hazard coordination strategy established	**2014**	●					Multi-hazard coordination strategy hardly exists before 2014.
		2018		●				There is marginal improvement and IMD send information to CWC, MC, Geology department, Agriculture department etc. However multi-hazard coordination needs to be improved since heavy rainfall leads to flash floods and landslides

Component 3 – Early Warning and Dissemination Systems

S. NO.	COMPONENT 3	YEAR	EARLY WARNING AND DESSIMINATION SYSTEMS

	CRITERIA		DEVELOPMENT STAGE INDICATORS					Description
			1	2	3	4	5	
3.1.1	Existence of dedicated EOC at city level for disaster management	**2014**		●				There is a city level EOC (Control Room) existing.
		2018		●				There is a city level EOC (Control Room) existing. Preparation of City DM plan was supported by UNDP and presently no dedicated staff. Control rooms is more for addressing chronic issues related to water, sanitation etc.
3.1.2	EOC is setup and functional at District and State level and is functioning	**2014**		●				The state EOC (SEOC) is located within the city. The SEOC is realized to function for the state and the city. Due to the presence of SEOC, there is no realization of need by the ULB or other technical institutions to establish a city EOC. District EOC is also located close to the MC building.
		2018			●			The state EOC (SEOC) is located within the city. The SEOC is realized to function for the state and the city. District EOC is also located close to the MC building.
3.2	Budget allocation by the local authority for EWS	**2014**	●					Budget head does not exist and currently, the expenses towards disaster preparedness/EWS are being made from miscellaneous heads. There is no evidence of realization of the need for having a separate budget for EWS.
		2018	●					The expenses towards disaster preparedness/EWS are being made from miscellaneous heads. Municipal authorities feel that DDMA is doing disaster management. So far, no dedicated budget available.
3.3	Data availability for operations of EWS	**2014**		●				Council of Science and Technology has made attempts to collate data for HRVA. SEEDS also did HRVA in 2009 for HP. ULB is currently not involved in the process
		2018			●			Detailed HRVA carried out at City level as well as state level for all the districts. IMD provides advisory for issue warning in case of extreme weather events.
3.4	Staffing and capacity within local authority for operation and maintenance of EWS	**2014**			●			Currently, the local authority provides only health advisories and related to water scarcity and similar chronic civic issues. Realization of need for dedicated staff for EWS is not evident.

		2018						Although dedicated staff not there, city emergency control room and Shimla DEOC are situated in the same compound and hence the realisation for need is not felt my municipal authority.
3.5	Use of modern technology to disseminate warning (hydro-met, public health)	**2014**						There are two sirens which are currently operational. One is located at EOC and other at IMD. There is a plan for installation of digital displays. Modern technology is being used for providing hydro-met warning. Health advisories are generally provided to public at large through local newspapers and television. Use of modern technology for disseminating warning does not exist for geophysical hazards.
		2018						There are sirens which are currently operational during drills only. Use of modern technology like VHF, WhatsApp (to counsellors, officials), face-book, SMS gateways etc. are used at different levels for dissemination.
3.6	Redundancy (multi-mode) in communication networks	**2014**						Recognition of need is evident within technical institutions and state authorities only
		2018						Multiple redundancy networks are not yet in place.
3.7	Outreach practice (dissemination of warning)	**2014**						Forecast exists for weather events, warning exists for all key hazards (excluding earthquake and landslide), and information is provided by IMD and health department to government institutions and media. There is lack of integration of existing warning systems with arrangements for service providers (transport, education, electricity, water supply etc.)
		2018						Integration of existing warning systems with arrangements for service providers (transport, education, electricity, water supply etc.) improved marginally since information is shared through social media.
3.8	Timely dissemination of warnings to vulnerable groups (residing in slums, high risk prone areas)	**2014**						Warning of disease outbreak is provided to slums through IDSP. No clear mechanism exists for warning of other hazards.
		2018						Warning of disease outbreak is provided to slums through IDSP. No clear mechanism exists for warning of other hazards till now.

3.9	Arrangement for night time warning (limited to floods, landslides)	**2014**	●					Arrangements for night time warning do not exist and the need is yet to be realized.
		2018		●				Arrangements for night time warning do not exist however the need is realized. However, village level DM plans are yet to be formulated and systems for night time warning to be set up.
3.10	Media engagement in dissemination of warning	**2014**		●				Media engagement with the forecasting agencies is evident specifically at the Meteorological Centre, Shimla. Media engagement in prevention of health risks is evident through engagement with the state department health agencies.
		2018			●			Media engagement with the forecasting agencies is evident specifically at the Meteorological Centre, Shimla. Media engagement in prevention of health risks is evident through engagement with the state department health agencies. Media is also involved in dissemination of warnings related to water shortage and other chronic issues.
3.11	Content of warning to general public by local government (ULB) (graphic representation and behavioural content for taking actions at individual/household and community levels)	**2014**	●					No formal mechanism for dissemination of warning to citizens and tourists exists
		2018		●				Adequate information for select hazards, but with no behavioural content and graphics

Component 4 – Response Capability

S. NO.	COMPONENT 4	YEAR	EWS GOVERNANCE - CITY LEVEL INSTITUTIONAL FRAMEWORK					
	CRITERIA		DEVELOPMENT STAGE INDICATORS					Description
			1	2	3	4	5	
5.1	Response Plans are in place and well tested and being updated regularly	2014		●				City DM plan developed in 2012
		2018		●				City development plan is revised in 2016 and yet waiting for approval form MC.
5.2	Extent of coordination between technical agencies and disaster management agencies	**2014**		●				Due to absence of city disaster management cell and functional city EOC, the state–district–city level agencies communicate on need basis. A well-coordinated mechanism to stage actions on receiving warning is not evident.
		2018			●			A coordinated mechanism to stage actions on receiving warning is existing through district administration although city level EOC is not much involved.
5.3	Extent of links between disaster management agencies and service providers	**2014**		●				No formal links between agencies is evident. Select service providers are informed during the onset of an event
		2018		●				Select service providers are informed during the onset of an event. There is no empanelment of service providers for involving during disasters.
5.4	Extent of links between media and disaster management agencies	**2014**			●			Reflection of warning information in media products is evident (information passed by IMD to local media). Links between media and technical agencies were found to be stronger with IMD through their frequency of interaction in comparison to the SMC.
		2018				●		Reflection of warning information in media products is evident (information passed by IMD to local media). Links between media and technical and disaster management agencies including SDMA were found to be stronger.
5.6	Mock drill is been carried out regularly	**2014**			●			Mock drills are been conducted regularly for fire hazards and Earthquake
		2018				●		Mock drills are been conducted regularly for fire hazards and Earthquake. Reports of the mock drills are been prepared regularly and available in SDMA website.

S. NO.	COMPONENT 4	YEAR	EWS GOVERNANCE - CITY LEVEL INSTITUTIONAL FRAMEWORK					
	CRITERIA		DEVELOPMENT STAGE INDICATORS					Description
5.7	Resources are available and inventory is prepared systematically	2014		●				Resource inventory is made as a part of DDMP and IDRN data is also maintained.
		2018			◐			Resource inventory is made as a part of DDMP and IDRN data is also maintained. But city DM plan is not including the resource inventory.
5.8	Capacity building of response agencies including NGOS	2014		●				Capacity building is been done through training programmes at Himachal Institute of Public Administration
		2018			◐			Capacity building is been done through training programmes at Himachal Institute of Public Administration and also with NGOS.
5.9	Extent to which the warning mechanism allows for feedback from affected area	2014			●			Communication of warning is more unidirectional – technical agencies to disaster management agencies (state/district/city). The authority to issue warning is with the state and the districts. For geophysical and hydro-meteorological hazards, there is no evidence of confirmation and feedback mechanism. In case of public health, it is achieved through field workers providing feedback on a weekly basis.
		2018			◐			Situation remains the same. Technical agencies to disaster management agencies (state/district/city). The authority to issue warning is with the state and the districts. Mechanism was initiated by IMD but only few back received from users. IMD received feedback from tourism and road transport department.
5.10	Monitoring, evaluation and targets for improvement of EWS	2014	●					No formal procedure to monitor the EWS performance is in place.
		2018		◐				Indicators for monitoring effectiveness of EWS are listed for the state in the EWS review of 2014. However, the indicators are not monitored regularly.

8. Status of EWS – Community Perspective

Effective "end-to-end" early warning systems shall be "people-centred". Dissemination and communication by the authorities about the impeding danger in a timely and accurate manner to the community is the most important element of EWS. These four interrelated components of EWS need to be coordinated within and across sectors and multiple levels for the system to work effectively and to include a feedback mechanism for continuous improvement. Failure in one component or a lack of coordination across them could lead to complete or partial failure of the whole system. It is important to make note that EWS will be considered as a successful one of the information reach last mile and the community is benefited by the same.

The present review of EWS, to understand the effectiveness of EWS, Household Survey has been carried out in all the 30 wards of Shimla City (Municipal Corporation Area). Total of 300 households were surveyed. Nearly 1% of the households in Shimla town was surveyed and 10 sample each from every ward of the Shimla town was selected randomly for the study. Map depicting the location of the surveyed households with in each of the ward of the Shimla MC Area is in the figure 2. House Hold Survey was found beneficial in understanding about how far the community has been benefited from existing EWS. Further, this has also helped in understanding the reasons why early warning information was not benefited the community.

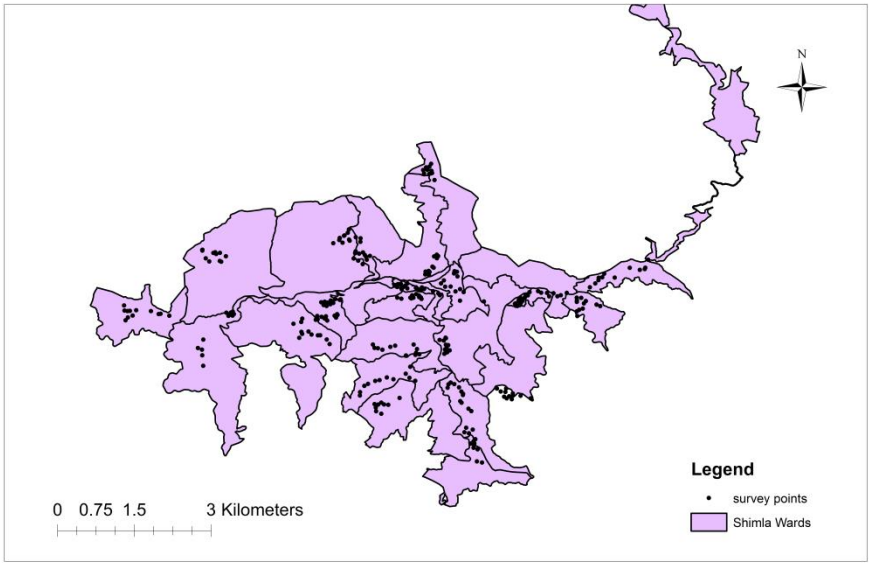


Figure 2: Map depicting the location of the surveyed households with in each of the ward of the Shimla MC Area

8.1 Risk Knowledge

Risk Knowledge is the first and foremost element of and EWS. Designing and implementing an EWS requires understanding of the hazards i.e. frequency, intensity, periodicity and spatial distribution. Also, communities understanding about hazards and risks will help in understanding and responding to warning messages effectively. Communities Risk Knowledge has been analysed based on the following factors.

- Awareness about the hazards like cloudburst, landslides, epidemics, etc.
- Hotspots are already identified? (Near road and gorge)? Is there any map in your ward where these hotspots are marked?
- Know about the recent disasters and their impact? Seasonality, sectoral impact etc.?
- Awareness about the impact of climate change?
- Is there any awareness campaigns carried out by the Govt., NGOs? Pamphlets distributed with do's and don'ts?
- Traditional knowledge for forecasting and warning (e.g. movement of clouds, behaviour of animals and birds etc.)?

Results of the analysis based on the house hold survey is summarised below for each of the variable/ indicator.

i. Knowledge about the hazards

From the analysis it is well evident that most of the people in the area are aware about the hazards and threats in their vicinity. According to 5% of the respondents the awareness about the hazards in the area is very high. According to 9% they have high level of awareness. However, 58% of the respondent mentioned that they are aware of few hazards and hence they feel only average, 14% low awareness and 14% of the respondents fall under very low awareness category. Percentage respondents falling under different level knowledge about hazards in there are depicted in figure 3.

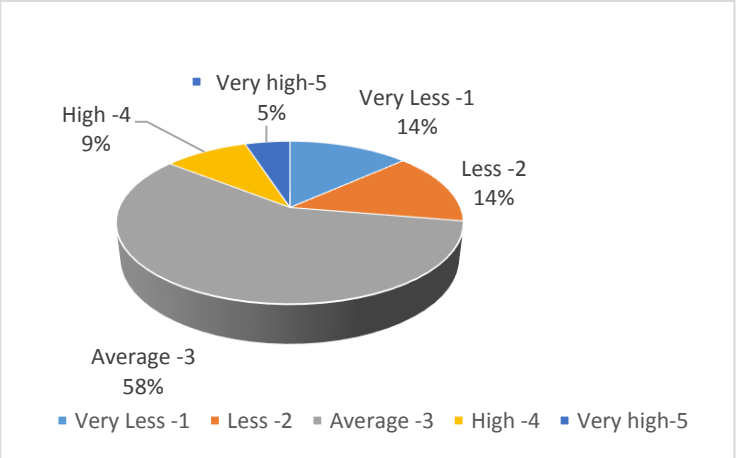


Figure 3: Respondents falling under different level knowledge about hazards

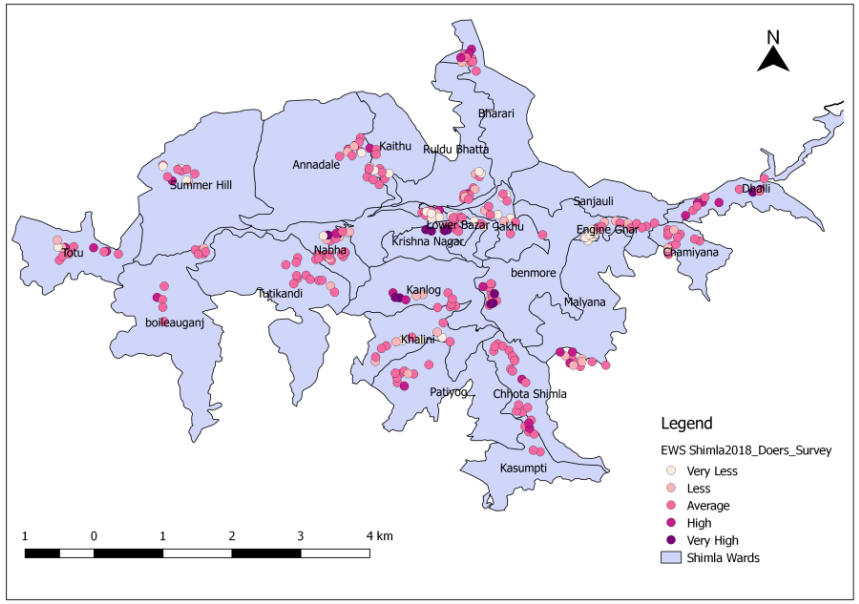


Figure 4: Map showing respondents falling under different level knowledge about hazards.

ii. Hotspots are already identified?

Respondents were asked whether they are aware of the dangerous spots in their vicinity. From the survey conducted, 25% of respondents mentioned that they hardly know about identified hotspots of hazards, and the major part 37% fall under the people who are aware of hazardous zones, 29% of them know about some hotspots, and only 3% respondents knew about most of the identified hotspots. From the spatial distribution map it is evident that awareness about hotspots is low to average in most of the wards. Some of the wards e.g. Engine Ghar none of the respondents are aware of the hotspots.

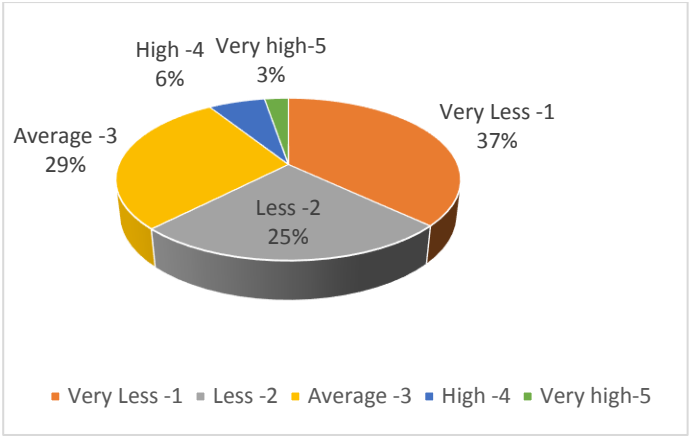


Figure 5: Percentage respondents falling under different levels of identifying hotspots.

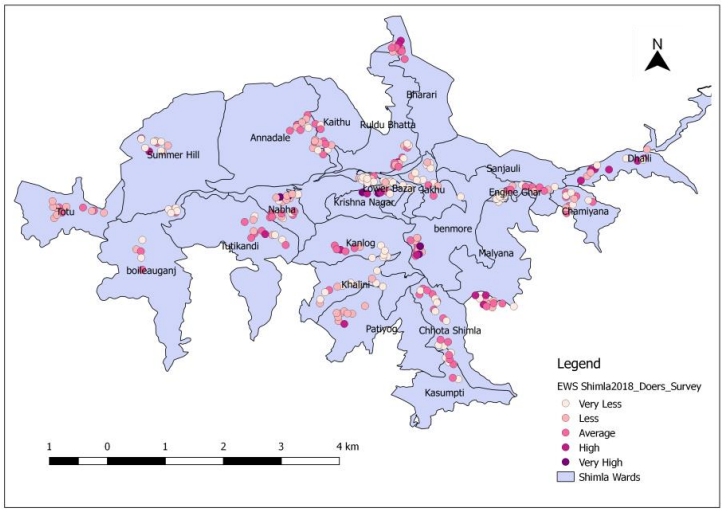


Figure 6: Map showing respondents falling under different levels of awareness about the hotspots in their vicinity.

iii. Is there any map in your ward where these hotspots are marked?

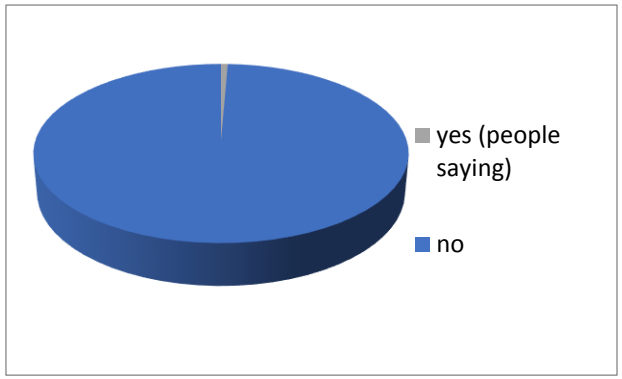


Figure 7: Percentage respondents who have ward map marked with hotspots.

According to more than 99 % of the respondents they are not aware of any maps showing the hotspots. Only 2 respondents mentioned that they have seen a map. One of the respondents is from Nabha and other is from Krishna Nagar ward.

iv. Do you remember about the recent disasters and their impact? Seasonality, impacts etc.?

From the survey, it is clear that 26% of respondents didn't experience disasters in recent times and have no idea about the seasonality. According to 42% of the respondents they have less idea and 26% of the respondents they have memory of the impact of few disasters and their impact. Five percent of the respondents remember well about most of the disasters happened in the recent time and 1% of the respondents mentioned that they experienced major impact of disasters and are aware of seasonality of such events.

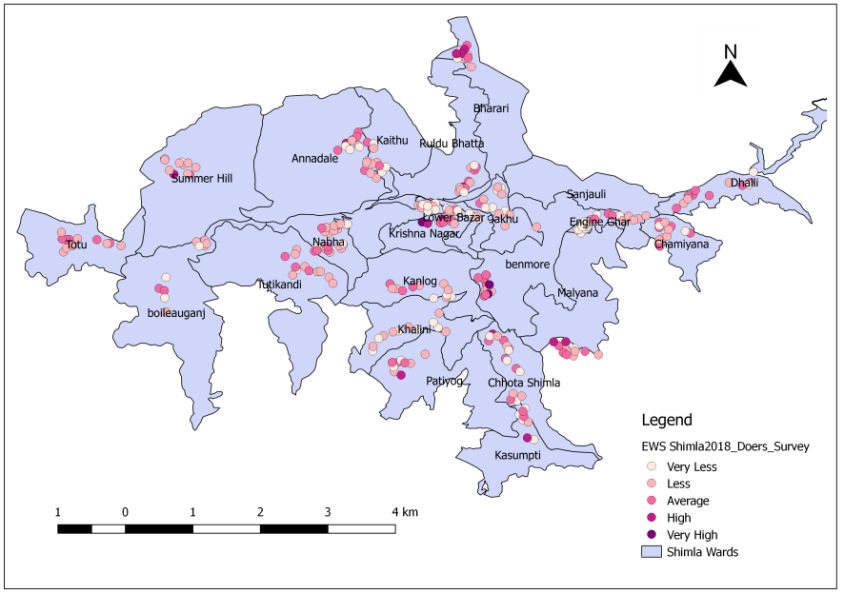


Figure 8: Map showing respondents experiencing different disaster impacts.

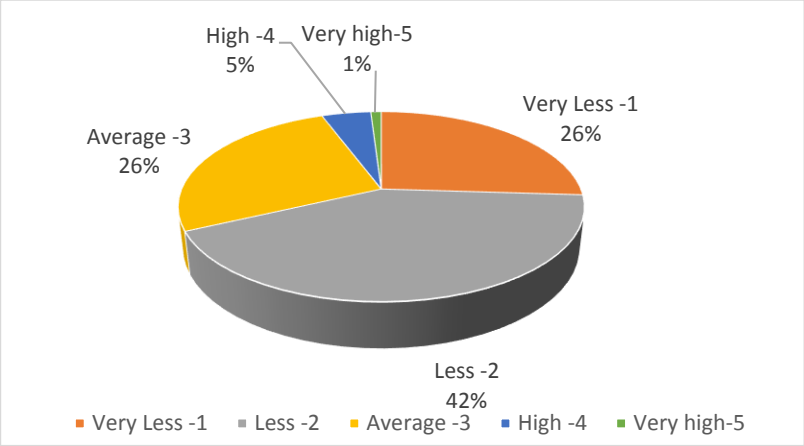


Figure 9: Percentage respondents remember about the seasonality and impact of disasters.

v. Do you feel the impact of climate change?

From the above pie chart (figure 10), the survey depicts that there are 46% of respondents who feel that impact in climate change is high and 26% of them felt very high impact of climate change, 22% of them observed medium range of impact and 5% respondents felt low impact of climate change. It is interesting to take note that most of the respondents feel the impacts of climatic changes in recent times more visible and they are relating it to extreme weather events.

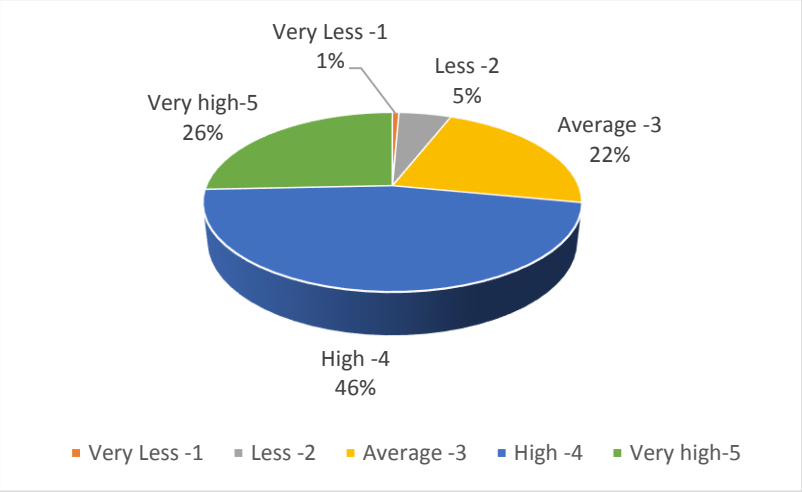


Figure 11: Percentage respondents experiencing different levels of impacts of climate changes.

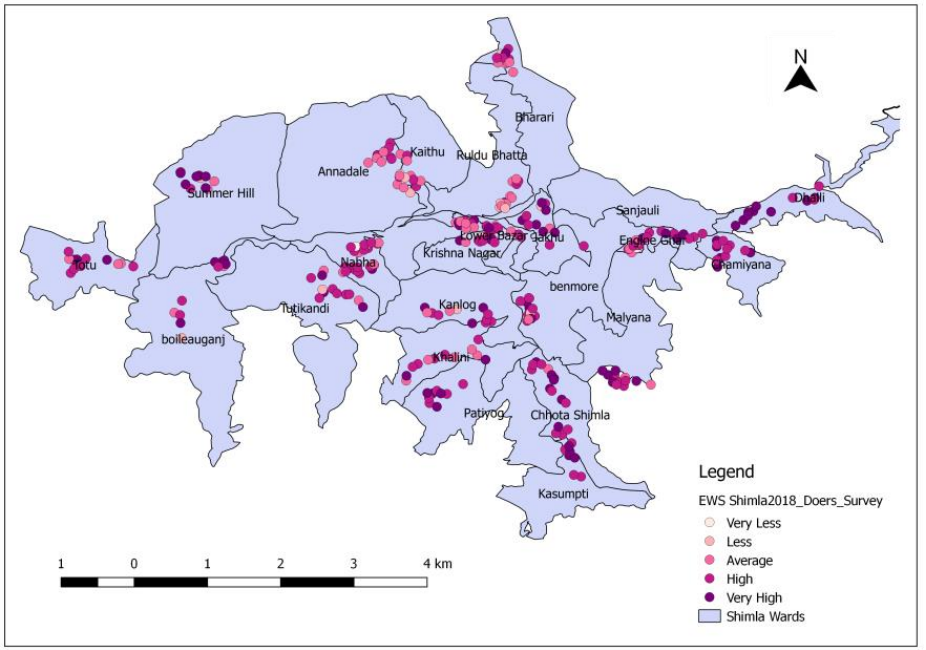


Figure 12: Map showing respondents experiencing different climate changes.

vi. Are there any awareness campaigns carried out by the Govt., NGOs? Pamphlets distributed with do's and don'ts?

From the survey, the pie chart (figure 12) it is evident that large number of people i.e. 55% of respondents do not know about any awareness campaigns by government regarding the do's and don'ts during disasters, 32% are having less awareness, and then 12% have average awareness regarding campaigns and only 1% of respondents are aware of govt. campaigns.

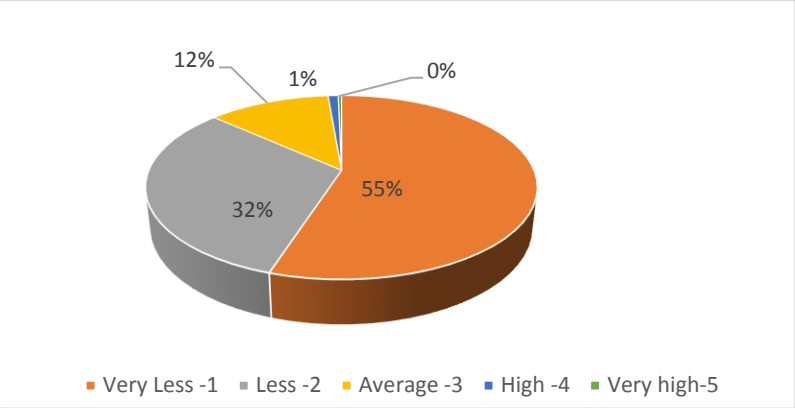


Figure 13: Percentage respondents falling under different level knowledge about hazards from government.

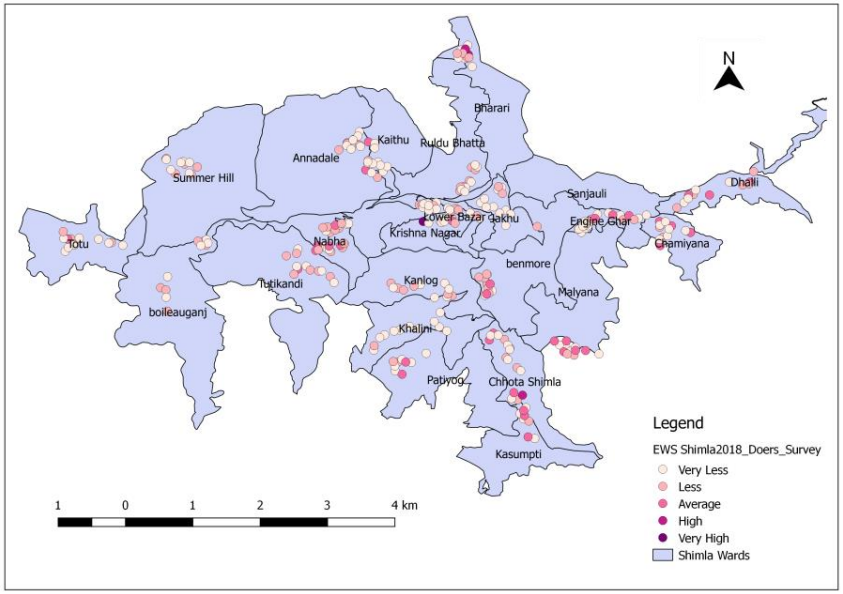


Figure 14: Map showing respondents falling under different level knowledge about do's and don'ts and the awareness campaigns carried out by government. NGOs etc.

vii. What is been traditionally done in the city in the past to protect from hazards?

The pie chart shows, 58% of respondents of the survey didn't have experience or awareness about any traditional protection methods in their city, there are 23% of them have seen some practices for protection during disasters and 2% of them seen the complete traditional protection methods for hazards.

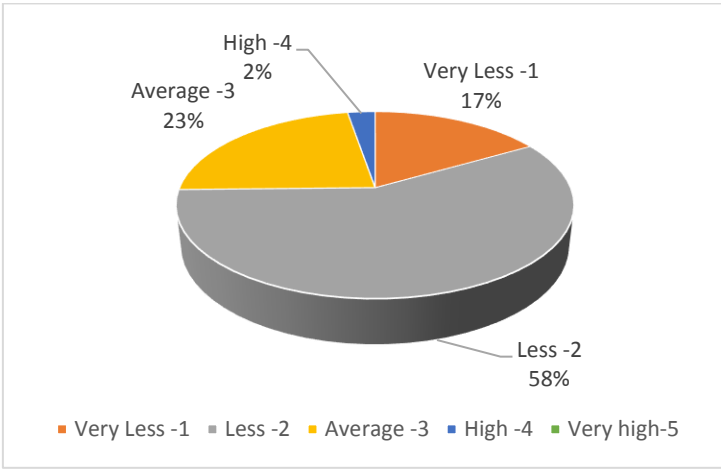


Figure 15: Percentage respondents falling under different level knowledge about hazards protection in traditional methods.

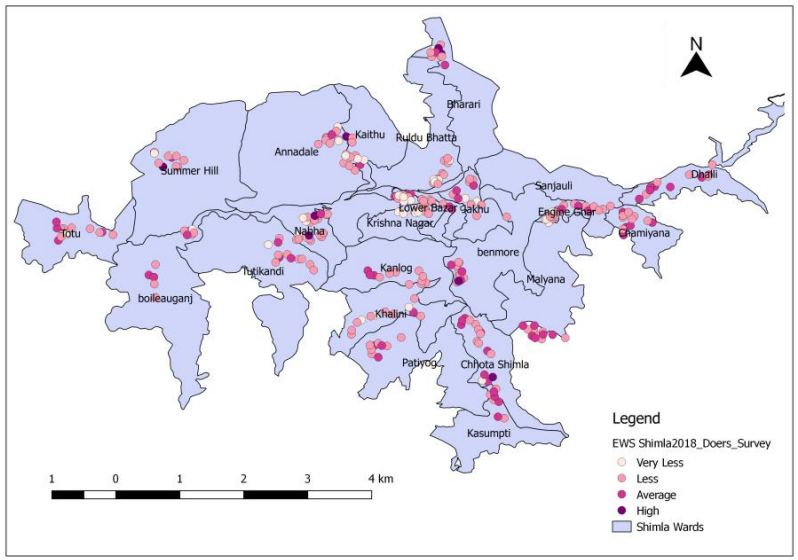


Figure 16: Map showing respondents falling under different levels of traditional knowledge for protecting from hazards

8.2 Forecasting and Warning:

i. Forecasting/ advisories issues by the department is adequate and enough?

The survey conducted says that, the major part 73% of respondents get accurate forecast information from the department and there are 16% of them rarely get accurate information, and 11% of respondents do not get information about any climate changes.

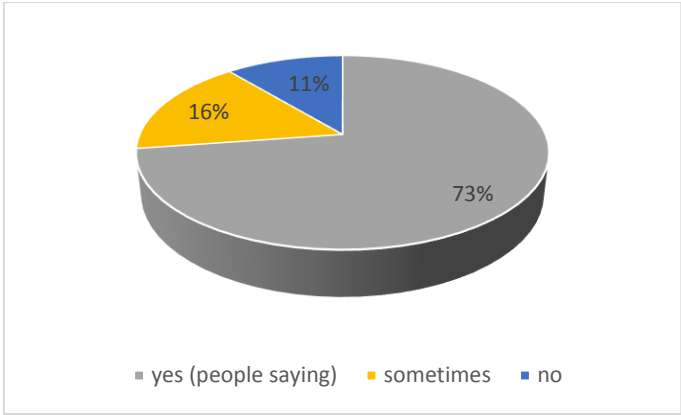


Figure 17: Adequacy of Forecasting and advisories issued by met department

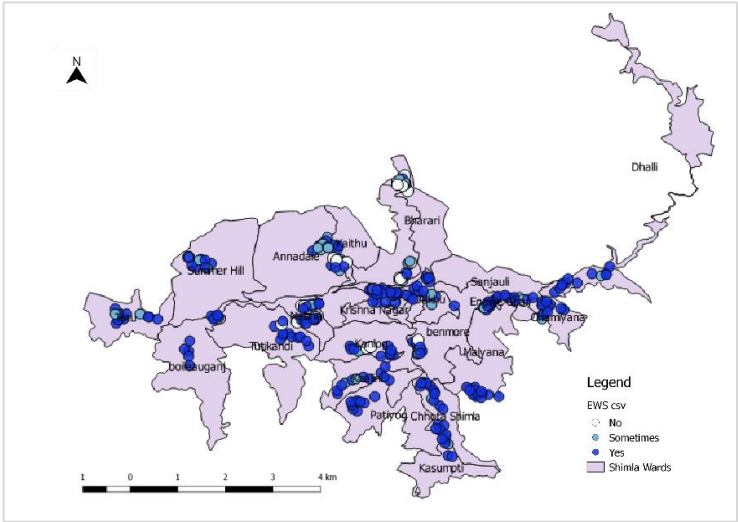


Figure 18: Adequacy of forecast message from met department

ii. Is this information correct and enough?

The pie chart shows, 44% of respondents get the correct and enough information to react accordingly, the major part 48% of them says the information is not enough and 8% of them says the information is not correct and enough.

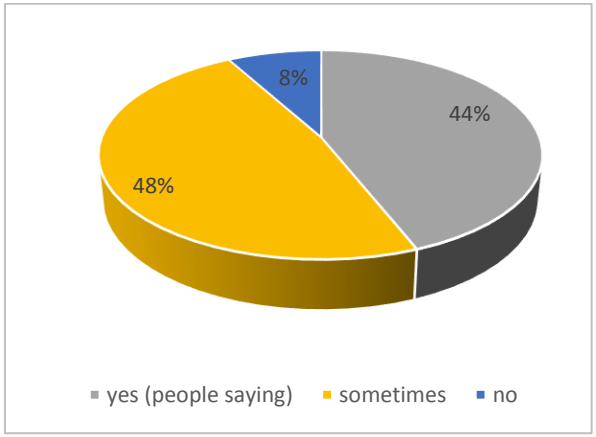


Figure 19:: Percentage respondents falling under different level accuracy in the knowledge about hazards.

iii. Do you get any information for Geological Hazards like Earthquake, Landslide etc.?

According to the survey, the pie chart shows, 53% of respondents do not get any information about geological hazards, the portion of 22% says only sometimes they get the alert information and there are 25% of them get the correct information about the hazards.

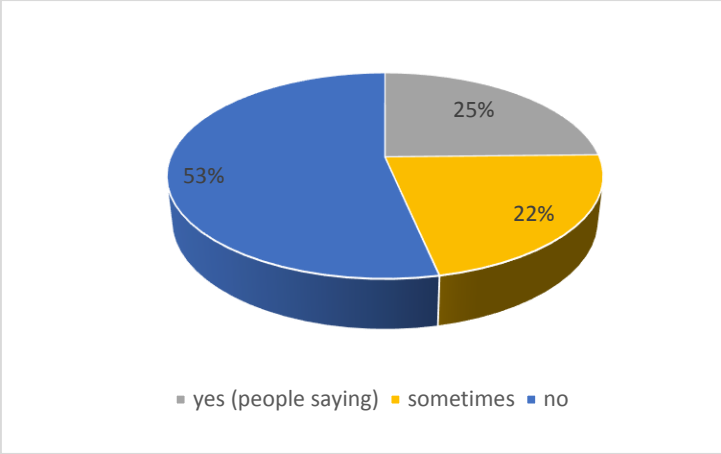


Figure 20: Percentage respondents receive warning about geological hazards

Source of receiving forecast information

Source-wise analysis for Hydro-met and Geological hazards depicts that 130 out of 300 respondents use Newspaper as a source of information, 125 use TV, 14 use radio, 4 persons by call or SMS, 45 from WhatsApp messenger, 69 from Facebook and 137 receive information from other sources like website or announces made by municipal corporation. It is worthwhile to make note that approximately 50% of the respondents are depending on newspaper and TV and one of the sources of the source of information. Use of radio is very less.

The survey results show that 71% receive forecast from more than 1 source. As depicted in the pie chart below 29% of them have 1 source, 32% of respondents have 2 sources for receiving information about forecasting and warning, 18% of them have 3 different sources, 19% of them have 4 sources, and 2% of respondents use more than 4 sources.

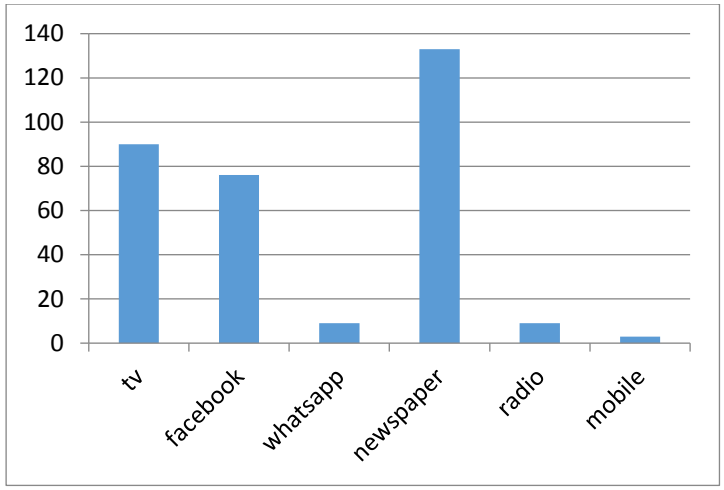


Figure 21(a): Respondents view about the credible source of forecast information

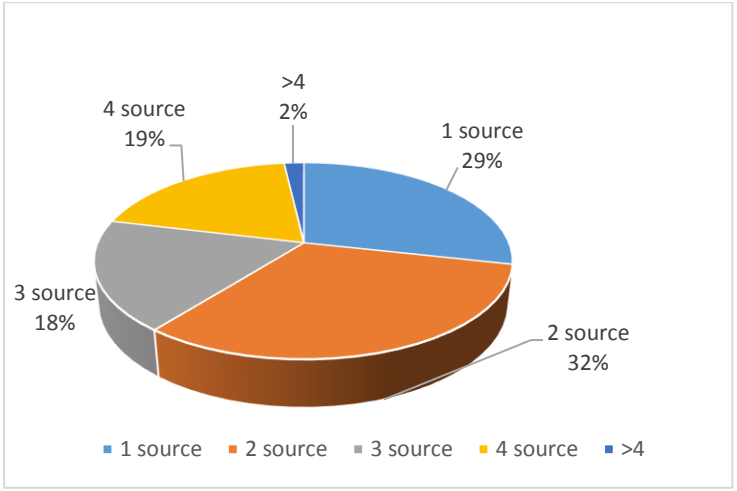


Figure 21(b): Percentage respondents using multiple media for receiving forecast and warning

iv. Disease surveillance system (surveillance coverage)? Advisory mechanism for public health risks (vector-borne and water-borne diseases) is in place?

As evident from the household survey, a large number of people, three-quarters of respondents benefit from disease surveillance system in their place, according 14% of them have limited access, and 11% do not receive information.

If yes, from which source you get the information?

Source-wise analysis of Information source for Disease Surveillance Systems depicts that 220 out of 300 respondents use Newspaper as a source of information, 197 receive from Tele Vision, 25 from radio, no persons by call or SMS, 50 from WhatsApp messenger, 105 from Facebook and 55 receive information from other sources like website or announces made by municipal corporation. It is worthwhile to make note that approximately 70% of the respondents are depending on newspaper as one of the sources of the source of information.

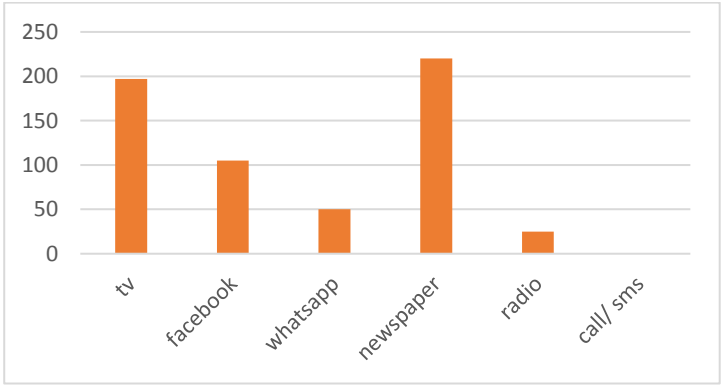


Figure 22(a): Source of receiving disease surveillance information

According to the survey, 41% of respondents use 4 different sources of information, 28% of them have only 1 source, and there are 24% of them who have 2 sources, 3% of them have 3 diff. sources, and 3% of respondents have more than 4 sources of information.

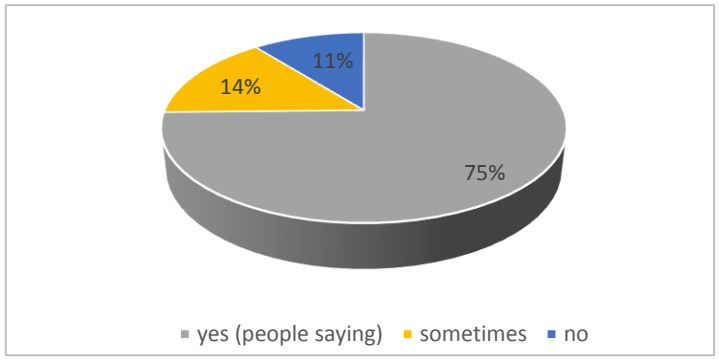


Figure 22(b): Percentage respondents receive information about epidemics and outbreaks.

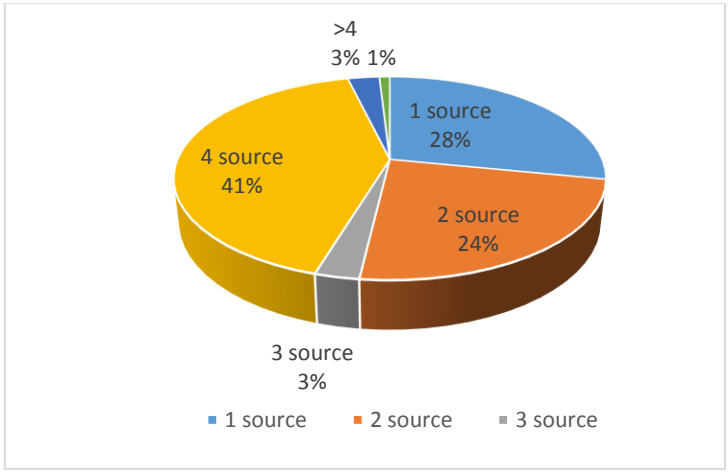


Figure 22 (c): Percentage respondents using multiple media for receiving disease surveillance information

v. Ability of technical agencies and disaster management institutions to cater their early warning products and services to user-specific requirements?

The pie chart depicts (figure 22) that 47% of respondents feel that the ability of technical agencies and disaster management institutions to cater their early warning products and services to user-specific requirements average response for services during disaster is just average, 33% of them think less ability, 15% capability is very less and according to 4% of the respondent ability is high and 1% very high.

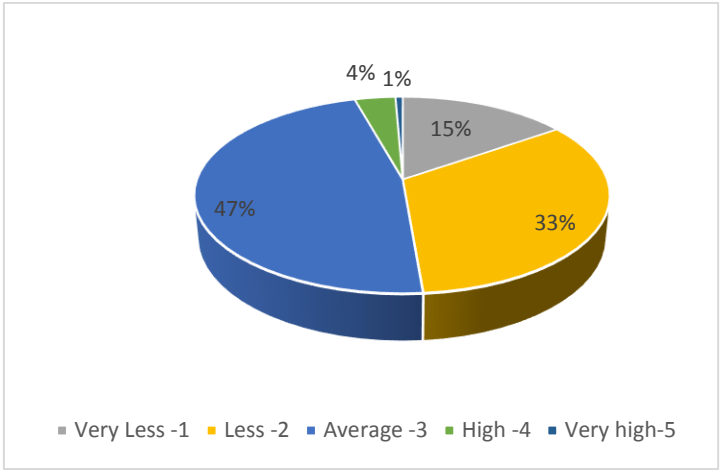


Figure 23: Percentage respondents falling under different level of response after hazards

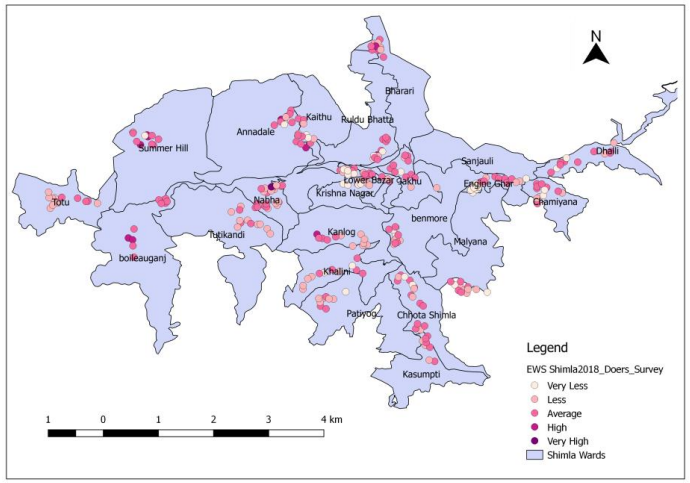


Figure 24: Map depicting the ability of the technical agencies to cater Warning products and services to user specific requirements.

8.3 Early Warning & Dissemination

i. Are you able to understand the warning messages issued by the agency?

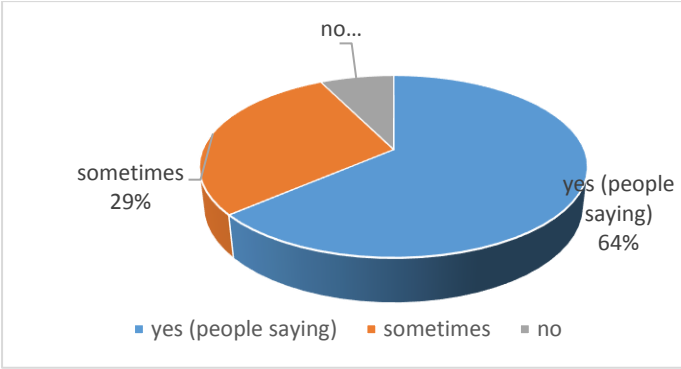


Figure 25: Percentage respondents falling under different levels of understanding of warning messages.

The HH survey depicts that 64% of respondents get clear warning messages from the agency, 29% of them says they understand the information rarely, 7% of respondents says they cannot understand the information.

ii. Is the warning containing information you require for preparedness and response?

As depicted in figure 26, 51% of respondents get the correct information for immediate action, 44% of them only sometimes get the required the information, and 5% of them do not get any information.

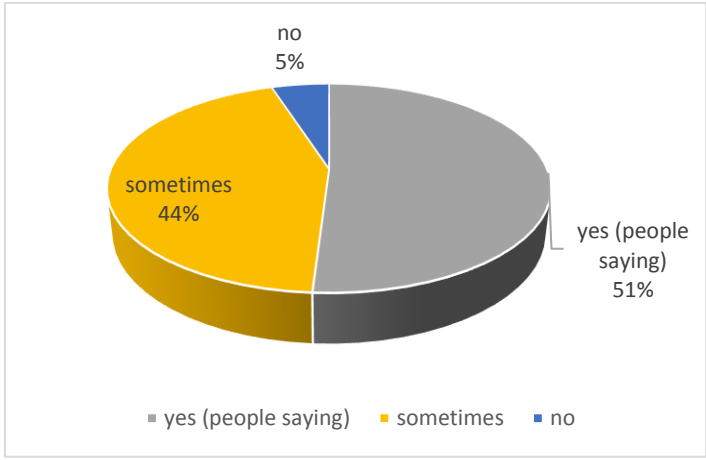


Figure 26: Percentage respondents feel the warning contains information you require for preparedness and response

iii. Do you receive warning on time?

According to the pie chart, the survey shows that 59% of respondents get hazard warning on time, 31% of them get warning in time, 10% of respondents get effected due to late warnings.

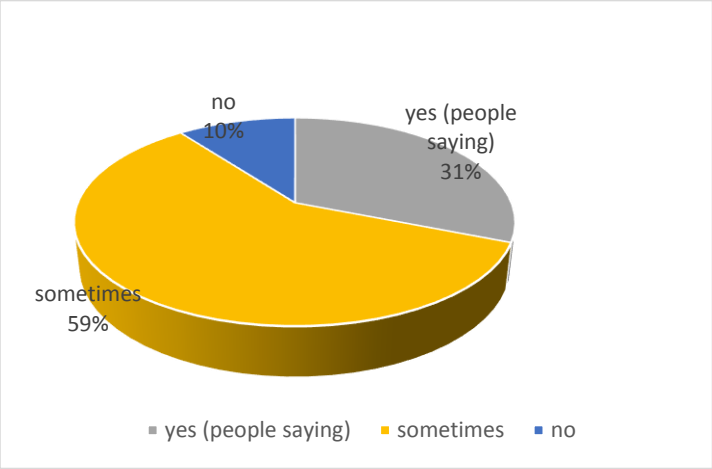


Figure 27: Timeliness of warning.

iv. Is there any agency or institution which issues disaster warning for chronic stress issues?

As depicted in the pie chart (figure 28), 49% of the respondents say there are few agencies and institutes, 43% of them says there are no such institutes or agency and 8% of respondents says there some Institute which issues disaster warning for chronic stress issues.

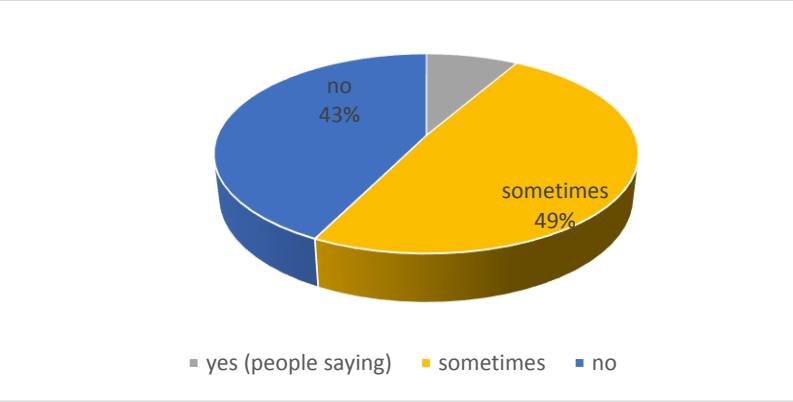


Figure 28: Respondents view about the existence of institutions or agencies which issues disaster warning for chronic stress issues

v. Whether have a cell phone? Are you using a smart phone? If Smart phone, using applications like WhatsApp, Facebook etc.?

Except 7% respondents all are having cell phones. Out of the respondent s using cell phone 220 are using smart phones and 73 are using cellular phones with basic functions (mainly elderly persons).

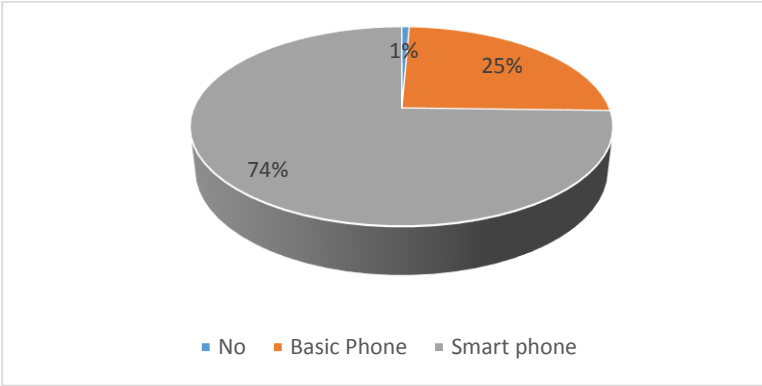


Figure 29: Cell phone usage and type (e.g. Basic phone or smart phone)

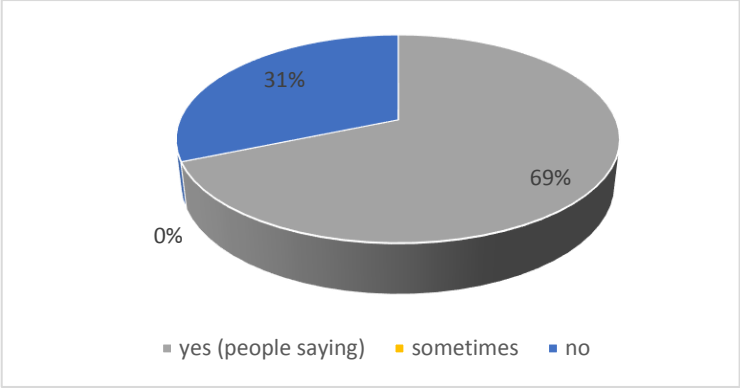
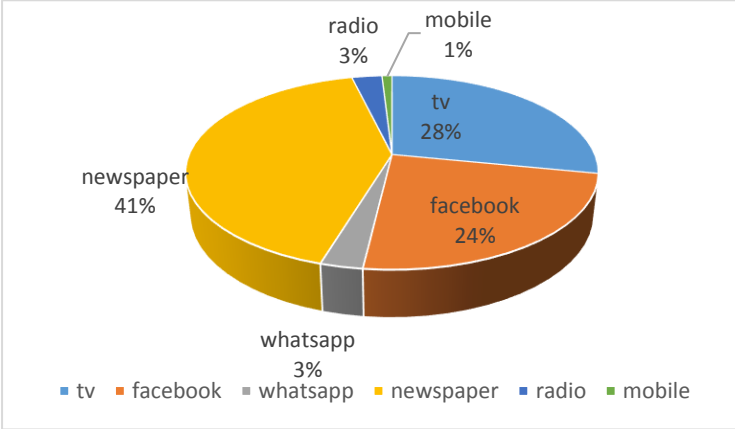


Figure 30: Percentage respondents falling under different usage of smart phone***s***.

According to the survey, the majority (69%) of respondents prefer to use smart phones, 31% of respondents do not use smart phone.

vi. Which medium is credible for early warning?



vii.

Figure 31: Percentage respondents falling under different level of credible early warning.

The survey results show that newspaper (41%) is the main medium for credible early warning, continued by 28% television, 24% Facebook, and other mediums like radio (3%), a very small number (1%) mobiles, takes the last place.

viii. Is the warning being credible?

The results of survey say, the warnings from different mediums are mostly credible, 4% of people say the warnings are completely useful.

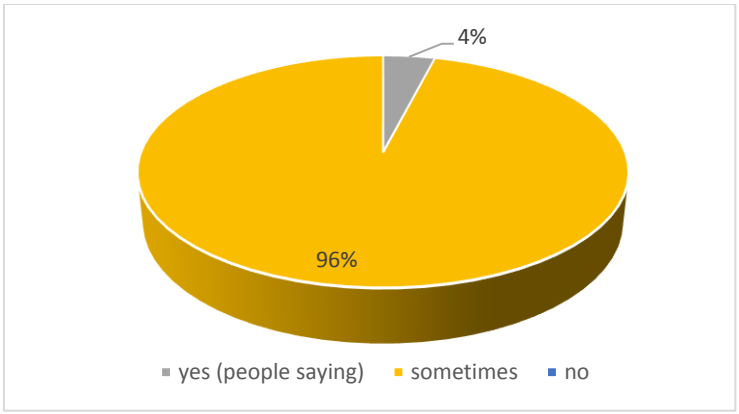


Figure 32: Credibility of warning messages

8.4 Response Capacity:

1. Are there any disaster management plans at WARD level or at apartment level? Are you aware of them?

Respondents mentioned that no Ward Level DM Plans are existing. If formulated they are neither aware and nor involved.

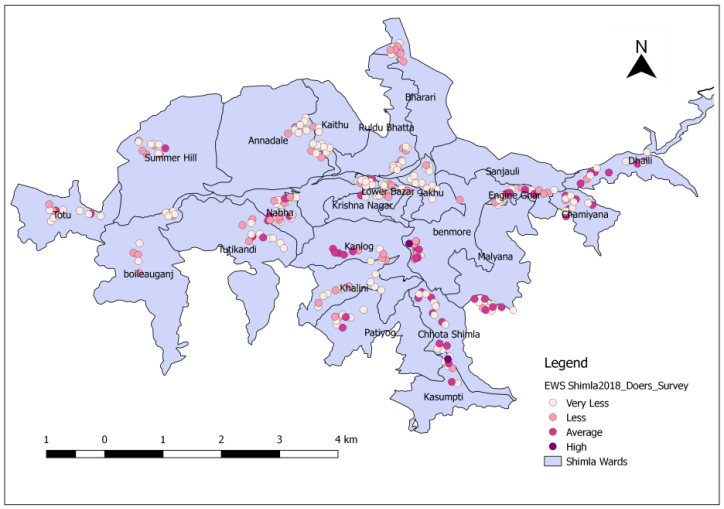


Figure 32: Respondents perception about the availability of DM Plans.

Figure 33: Percentage respondents falling under different level knowledge about disaster management plans.

I. Are there any mock drills done at community level?

From the survey results, we can understand that 98% of respondents never participated or witnessed a mock drill at community level. However, hazard specific drills are been conducted in public places, schools etc for few hazards like earthquake, fire etc.

If yes, for which Hazard the mock drills conducted?

From the bar chart, it is evident that most of the responds never participated or witnessed any drill. Even at community level no plan is existing. Although drills are been organised by SDMA at regular intervals for earthquake, fire etc. at malls, schools and public places, most of the respondents are not aware. Respondents do not even have clarity about what is meant by a drill. From the interaction with participants it is evident that they are misunderstanding demonstration by departments as drill.

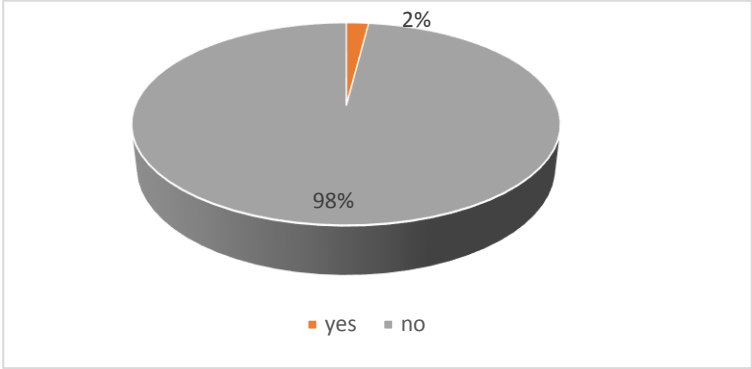


Figure 34: Percentage respondents falling under different level knowledge about mock drill at community level.

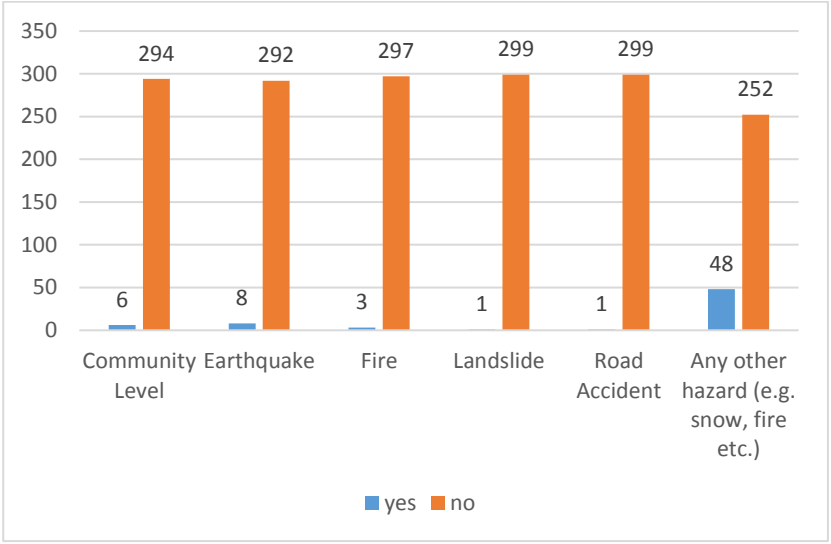


Figure 35: Status of mock drill for various hazards

3. Do you have community level mechanisms to respond to disasters?

As evident from the house hold survey 98% of respondents think that there are no active community level mechanisms to respond to disasters. There is no trained person at community level and ward level plans are not existing and 2% think some level of community response is there.

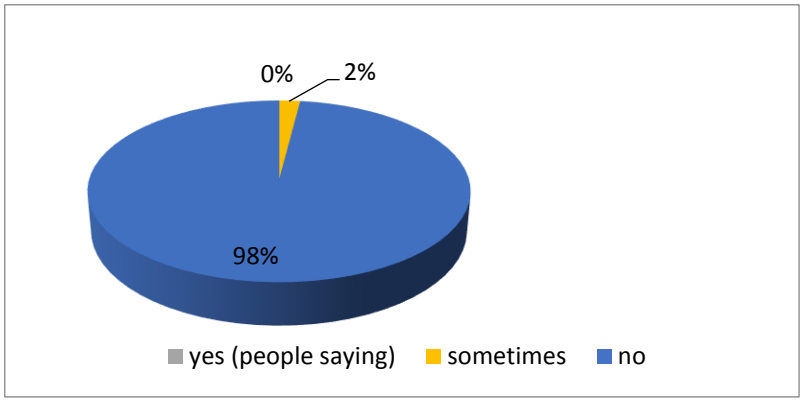


Figure 36: Existence of response mechanisms at community level

9. Highlights of the analysis

From the analysis of the HH survey data and interaction it is evident that People do get news from newspapers, radio and news channels about the weather forecast for the coming days (usually, for the next 5-7 days). While this information is somewhat useful, it is very general in nature, and can't help much in decision making.

One of the most significant progress made with reference to EWS is the occasional use of SMS Gateway by the DEOC to send alert messages among the key officials and public representatives whenever the DDMA receives severe weather warning from the Met Department. Met department also send SMS and WhatsApp messages to transport department and tourism department.

With reference to the Agriculture/Horticulture Sector (not related to Urban context), the farmers and orchard owners also receive similar messages when there is a prediction of hailstorms or frost.

In the rainy season, the messages from department of Public Health & Family Welfare are broadcasted through Radio and TV channels that people should boil water for 15 minutes before consuming it. We can assume that these messages are useful for behavioural change among some people for mitigating the risk of water-borne diseases.

There is no mechanism for creating early warning products for hazards like landslide, earthquake, or communicating the same through any means. The following measures can be adopted in short, medium and long term.

Disaster databases and information should also be made available and if possible in local language as well, to ensure accessibility of information to public.

Response capacity is still low and local governments do not have capacity to implement the plans although a DM Plan is formulated at city level. Ward level DM plans are not existing and mock drills are not practiced at regular intervals.

Although at city level interaction with government functionaries shows improvements in terms of risk knowledge and forecasting and warning systems. Risk assessments are carried out at the city level as well as us state district levels. Updated DM Plans are also available.

10. SWOT Analysis of End to End EWS

Strength – Weakness -Opportunity – Threat analysis (SWOT) has been carried out based on the information obtained through literature review and participatory methods. Highlights of the SWOT analysis are given below.

(i) Strengths in existing EWS

The city of Shimla has made substantial on all the elements of End to End EWS. The state has always been one of the progressive states as far the disaster management planning is concerned. HRVA studies were carried out for state in the 2009 and in the year 2016. Shimla is one of the few cities in the country where a detailed HRVA for all the hazards are been carried out at the city level. The maps and reports of the HRVA studies are uploaded in the website of HPSDMA and is accessible to all for view and downloading. HPSDMA also have a web-portal for the HRVA studies. Disaster Management Plans at the state, district and city level is having HRVA chapter and seasonality, frequency analysis also included in the plans. Emergency Operation Centre is set up at state level and hosting HRVA. District level also there is a well-established 24/7 fully operational EOC existing. Media is proactive in the city and contribute in dissemination of warning related to disasters as well as chronic stress. Disaster Management Plans have the component of EWS. Community level analysis also depicts that people are aware of the hazards in their vicinity. Large number of respondents believe that they receive information about forecasts from met department through newspaper and TV.

(ii) Weakness

Although risk assessments are been carried out, they not been used by the Municipal Corporation or line departments. Discussions with the scientific agencies clearly shows that the agencies contributed data for HRVA. However, the risk assessments are not been used in designing or improving the forecasting systems. Municipal corporation is not having much role as far as the disaster management is concerned. Shimla MC is not having an emergency operation centre. There is a control room where services related to municipal issues like water, sanitation, waste management etc. are handled. At Ward level DM Plans are not prepared and the elected members (counsellors) have limited role in disaster management. Community at large is not aware of the existence of any assessments or plans as evident from the house hold survey. At ward level mock drills are not been conducted.

(iii) Opportunities

Government of HP is proactive and have already taken steps for establishing people centric EWS. State government already carried out the needs assessment and communicated to central agencies. Doppler weather radar will be in place soon and this will help in now casting. IMD Shimla has been actively supporting the state and district authorities as well the few line departments viz. tourism, roads, railway etc. UNDP is been supporting state government and other agencies like World Bank and GIZ are also supporting in implementing programmes related to disaster risk reduction and climate change. Under the UNDP support staff is been recruited for the disaster management department as well as for emergency operation centres. Sendai

framework is also an opportunity and governments are initiating steps towards setting up EWS, reviewing the status of EWS and improving them.

(iv) Threats

At present the role of municipal corporation in EWS is included in the DM Act. Municipal authorities do not have capacity to carry out Risk Assessments or preparation of DM Plans. Most of the disaster management department staff are project supported and regular officials are not been recruited for carrying out functions. State and district functionaries are been transferred frequently. Institutional knowledge is not been captured and transferred yet. Risk assessments carried out are not been used and hence the authorities never think it is essential to upgrade them.

11. Way forward

(i) Short term (with existing infrastructure) measures

- Improving coordination between different departments
- Risk Information and dissemination. Hosting the information at MC and other relevant departments. Although HRVA done is yet to be disseminated and used in decision making.
- Update Risk Assessments periodically. Risk is dynamic and hence HRVA studies needs to be updated at least once a year.
- Capacity development of the officials needs to be carried out so that they can update the non spatial information in the online system periodically. For example information about the population, vulnerable people etc. can be updated with-out much efforts to keep the system up to date.
- Collect, collate and analyse the disaster, damage and loss database for small, medium and large scale disasters. This will not only help in understanding the hotspots and spatio temporal trends, but also the progress made in DRR interventions. Disaster damage and loss data needs to integrated with the HRVA studies.
- Capacity Development including training on Early Warning Systems, Risk Assessment, Response planning etc.
- Weather forecasting mechanisms and advisories needs to be made more user-friendly and contextual.
- Media can be involved for addressing the needs of people with disabilities and other vulnerable groups (e.g. subtitling of information for hearing impairment)
- Private Public Partnership and Involving Telecom Service Providers for SMS based warnings.
- Updating of India Disaster Resources Network and developing GIS based dynamic resource mapping platform. Mobile app to be developed for capturing geocoded information on resources available with the key departments.

(ii) Middle to Long term measures

- Micro mapping of resources for effective preparedness and response. At present non spatial mapping of district level resources are existing in IDRN Portal. How-ever the portal is developed during 2003-04. Now with the advances in

Geospatial technology it is possible to geocode resource information and develop online dynamic resource mapping.

- Built on Risk Knowledge (Disaster Databases and HRVA) : Budget needs to be allocated for review and revising of HRVA at least once in 5 years. Also there is a need to develop and maintain historical data of disaster damages and loss for minimum 30 years to carry out a statistically meaningful analysis.
- Increase Density of weather stations : State governments with the meteorological agencies needs to focus on increasing the network of weather stations. Being a mountain state the weather condition vary considerably with in the same district or even with in the city area it self.
- Sensor based systems and IoTs – Focus should be given on Sensor Based low cost systems for collecting real time data.

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